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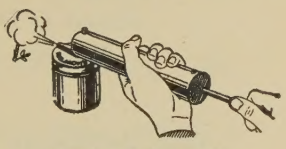

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LARSON (R. H.) & WALKER (J. C.). **A Mosaic Disease of Cabbage.**—*J. agric. Res.* **59** no. 5 pp. 367–392, 15 figs., 45 refs. Washington, D.C., 1939.

The following is taken from the authors' summary: The mosaic disease of cabbage discussed in this paper is one that has been extremely destructive in south-eastern Wisconsin [*cf. R.A.E.*, A **25** 318]. The symptoms in cabbage and many cruciferous and non-cruciferous hosts are described. All the cruciferous hosts, both cultivated and wild, that have been tested were susceptible, and among non-cruciferous hosts are three important crop plants, Swiss chard (*Beta vulgaris* var. *cicla*), sugar-beet and spinach, and three ornamentals, larkspur (*Delphinium ajacis*), *Petunia* and *Zinnia*. The reactions of several species of *Nicotiana* are described because of their importance in distinguishing the virus from others. A list of plants that did not become infected after inoculation is given.

Three insects that are common in commercial cabbage fields, *Myzus persicae*, Sulz., *Brevicoryne brassicae*, L., and *Pieris rapae*, L., are vectors. *B. brassicae* acquired the virus from diseased cabbage in a feeding period of 30 minutes, but *M. persicae* required an hour to do so. Both Aphids infected healthy plants in a feeding time of 30 minutes. Both alate and apterous forms of the two Aphids are vectors.

Environmental conditions play an important part in the destructiveness of the disease and the expression of symptoms. The disease is most severe at temperatures of 24–28°C. [75·2–82·4°F.], within which range stunting and necrosis occur. New foliage shows no symptom when infected plants are kept at 16°C. [60·8°F.] or lower. The virus is transmitted mechanically with the aid of carborundum as an abrasive. It has been recovered from young seed pods and immature seeds of cabbage, but not from mature pods or seeds. Seed-transmission has not been finally proved. It has been demonstrated that overwintering cruciferous weeds are an important reservoir in south-eastern Wisconsin. Indications from preliminary trials confirm field observations that certain cabbage varieties are more tolerant to the disease than others.

Entomological Investigations.—*Rep. Dep. Agric. St Lucia 1938* pp. 33–38, 1 ref. St. Lucia, 1939.

This report on insect pests in St. Lucia in 1938 consists chiefly of a section by R. G. Fennah recording work on *Diaprepes* spp. infesting *Citrus* [*cf. R.A.E.*, A **28** 88, etc.]. In general, infestation of the roots by the larvae was lighter than in previous years, and damage was correspondingly less. The abundance of egg-masses in each area increased between 7th May and the second or third week in June and then declined abruptly. The agricultural aspects of the method of control that consists in excavating a basin round the main roots of the tree [**26** 403] were examined. Experiments in Montserrat on trees 9 years old and in St. Lucia on trees 5 years and 1–1½ years old uniformly indicated that such exposure did not affect stability. Even if no drain is cut, water-logging does not occur. Drying out was investigated on the same trees and on young material of which some was given a heavy or normal mulch and some had no after-treatment. Humidity was low during the period March–May, but all trees, irrespective of after-treatment or soil, remained as vigorous as untreated trees. *Tephrosia candida*, a cover-crop that is avoided by

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the weevils [**26** 751] and assists the growth of the trees, was distributed for general use. Total immersion of larvae in de-oxygenated water for 24 hours did not kill them. Parasitism of eggs by species of *Tetrastichus* and *Ufens* during the oviposition season had risen to over 60 per cent. by the end of the first week in July. This was much higher than in previous years. Evidence was obtained that both these parasites are carried over from one oviposition season to another in St. Lucia on occasional egg-masses of *Diaprepes* laid out of season. In Dominica and Montserrat, parasitism by *T. marylandensis*, Gir., was consistently higher than that by other species, including those found in St. Lucia. It was introduced into St. Lucia from Dominica in July, but it is not known whether it has become established. In an investigation on the cause of red-root disease of limes, mutilation of the roots similar to that caused by *Diaprepes* failed to produce the symptoms shown by trees dying of the disease.

Mirax insularis, Mues. [**25** 678] was introduced from Dominica for the control of the coffee leaf-miner [*Leucoptera coffeella*, Guér.], but has not yet been recovered. A consignment of Coccinellids from Trinidad arrived in poor condition; the survivors were released on coconut palms infested by *Aspidiotus destructor*, Sign., but failed to establish themselves.

The Division of Entomology.—*Rep. Dep. Agric. Malaya 1938* pp. 73–76. Kuala Lumpur, 1939.

Consignments of the Hydrophilid, *Dactylosternum hydrophiloides*, Macleay, the larvae of which are predacious on the banana borer, *Cosmopolites sordidus*, Germ., were dispatched to Jamaica from Malaya at the end of 1937, and a small proportion of the insects arrived alive; a consignment despatched to Queensland arrived in excellent condition.

Preliminary statistical analysis of the results of research work still in progress on rice-borers, mostly *Diatraea polychrysa*, Meyr., in Malaya indicated that there is a high positive correlation between yield and surviving tillers produced in the first three months; there is no correlation between yield and surviving tillers produced in the fourth and subsequent months; there is, for individual fields, a high positive correlation between number of egg-masses found in the first 16 weeks and number of tillers 1–3 months old that are killed by borers; and a fairly high negative correlation between yield and egg-masses found in the first 16 weeks. It appeared that rice plants cannot be kept free from borers by the collection of egg-masses. When rice plants 45 days old were exposed to infestation in cages, the yield was considerably greater when the exposure period was one month than when it was two or three months, but the difference in rice exposed for two or three months was not significant. The importation of the Amazon fly, *Metagonistylum minense*, Tns., into Malaya for the control of *D. polychrysa* is under consideration [*cf. R.A.E.*, A **28** 304]. Experiments on the cause of seedless glumes, which have been prevalent in one area, indicated that the Delphacid, *Sogata furcifera*, Horv., is probably responsible, and available evidence suggests that it is also responsible for the condition known as penyakit merah (red-disease).

It has been established that *Pseudococcus brevipes*, Ckll., which is prevalent on pineapples throughout Malaya, induces green spotting of the leaves, and that pineapples showing alleged symptoms of mealybug wilt have recovered when planted in good soil and placed under

shade. Of poison baits tested against *Dacus* (*Chaetodacus*) *ferrugineus*, F., a solution of formaldehyde and sugar was the best. It was equally attractive to males and females, and remained effective for several weeks. Infestation of chillies [*Capsicum*] by this fruit-fly was reduced by spraying the plants with sodium fluosilicate.

LEVER (R. J. A. W.). **Entomological Notes.**—*Agric. J. Fiji* **10** no. 3 pp. 83–87, 15 refs. Suva, 1939.

In April 1939, serious leaf-yellowing of rice caused by the Delphacid, *Sogata furcifera*, Horv., occurred in two districts on Vanua Levu; it was worst in the areas in which the rice was permanently flooded or in which rain had been heavy or persistent. The control measures recommended were draining for 2–3 days, spraying the plants from a watering can with a suspension of 1 lb. derris in 10 gals. water, or scattering rice bran or sawdust impregnated with kerosene on the water in the field. The cutworms, *Spodoptera mauritia*, Boisd., and *Cirphis unipuncta*, Haw., caused severe damage to rice in the Rewa Delta on Viti Levu by biting off the heads of young flowers or feeding on the leaves [*cf. R.A.E.*, A **27** 213]. They were also very abundant in grassland along the tributaries of the Rewa. An arsenical bait was used, and the severity of the infestation was considerably reduced by the toad, *Bufo marinus*, which fed on the larvae [*cf.* **27** 641]. Flooding fields of rice for 2–3 days about a fortnight after transplanting is recommended against *S. mauritia*, as the moths are attracted to recently sown rice in water-logged soil, and standing water kills the larvae. *Leptocorisa varicornis*, F., which is usually found in Fiji on grasses, occasionally injures rice by sucking the sap from the grains when they are in the stage of milky ripeness.

Pests of stored rice in Fiji include *Oryzaephilus surinamensis*, L., *Tribolium castaneum*, Hbst., and *Calandra* (*Diocalandra*) *oryzae*, L. *Necrobia rufipes*, DeG., and *Alphitobius laevigatus*, F., have been found regularly in rice bran obtained from a merchant in Suva.

Doubt is expressed as to whether the termite identified in 1939 as *Calotermes* (*Cryptotermes*) *brevis*, Wlk. [*cf.* **28** 136] was really this species; it may have been *C.* (*C.*) *buxtoni*, Hill, which was previously recorded as occurring in Fiji [**27** 641]. Since then, a strong colony of this termite was taken by the author in a piece of three-ply wood in Suva, and this has proved to be the same material in which a colony was taken in 1933, also in Suva.

THOMAS (P. H.). **Control of Canary Fly.**—*Tasm. J. Agric.* **10** no. 3 pp. 152–153. Hobart, 1939.

Observations in Tasmania over a number of years have shown that the most effective control of *Typhlocyba froggatti*, Baker, on apple is afforded by two applications of a spray of nicotine sulphate, alone or in combination with lead arsenate [*cf. R.A.E.*, A **24** 787] or sulphur, the first before most of the nymphs reach the winged stage and the second 3 weeks later. Since this treatment is expensive, investigations were made in the summer of 1938–39 on the substitution of lime-sulphur for the first nicotine spray. Complete control throughout the season was given on one plot by applications on 2nd November and 5th December of nicotine sulphate (1 : 640) to which was added lead-arsenate paste (1 lb. to 15 gals.) and, in the second application, colloidal

sulphur (1 lb. to 15 gals.), while the substitution in the first application of lime-sulphur (20 per cent. polysulphides) at a dilution of 1 : 50, for the nicotine sulphate gave good control, but the trees were lightly infested towards the end of the season. On another plot sprayed on 27th October and 24th November, the control given by nicotine sulphate (1 : 640), with the addition, in the second application, of atomic sulphur (1 lb. to 12 gals.) was superior to that obtained when lime-sulphur (1 : 40) was used for the first application, but light infestations developed on all trees in early January, and a further application of nicotine sulphate was required. This may have been due to the earlier dates of application and the shorter interval between them, and to unfavourable weather conditions, which reduced the effect of the nicotine.

SALAMAN (R. N.) & WORTLEY (W. R. S.). **Potential Hosts of Potato Viruses in Garden and Field.**—*Nature* **144** no. 3660 pp. 1049–1050. London, 1939.

In experiments at Cambridge in 1938, the virus of potato leaf roll was transmitted by grafting to *Matthiola* and *Campanula*, which behaved as symptomless carriers. Investigations were therefore made in 1939 on the possibility of wild and cultivated crucifers acting in the same way.

The virus was transmitted to a turnip and from it to potato by grafting and to a plant of Brussels sprouts and from it to potato by *Myzus persicae*, Sulz. Neither of the cruciferous hosts showed symptoms of disease, but the potato showed typical leaf roll in the first case and a poorly developed and ambiguous syndrome in the second.

In a large number of cases, however, a virus carried over to the potato and thence to tobacco or *S*[*olanum*] *glutinosum* from infected crucifers or other foreign hosts was the Y virus (Sol. virus 2, K.M.S.), and not leaf roll. Careful checking of all controls and examination of the potatoes from which the leaf-roll virus had been obtained showed that the latter harboured the Y virus, although they had been exhibiting acute leaf roll for nearly 20 years without a sign of the usual symptoms of Y virus. It was found that Y virus could be carried by turnip, cabbage, kale and Brussels sprouts without symptoms and could be transmitted from them to potato by grafting or by means of *M. persicae* ; and that red clover, garden pea and bindweed [*Convolvulus arvensis*] could be infected by means of *M. persicae* without showing symptoms. Since the Aphid often overwinters on cruciferous vegetables [*cf. R.A.E.*, A **22** 386 ; **24** 61], it is possible that both these and bindweed may act as reservoirs for the potato viruses during the winter.

SCHWEIZER (J.). **Jaarverslag Tabak over Juli 1938 t/m Juni 1939.** [Annual Report on Tobacco from July 1938 to June 1939 inclusive.] —*Meded. Besoekisch Proefst.* no. 64, 64 pp., 1 pl. [Djember] 1939.

This report of the Besoeki Experiment Station, Java, includes notes (pp. 40–52) on insect pests of tobacco and their control. Insects were more abundant than in previous years, probably because wild food-plants were luxuriant, owing to prolonged rains. Good control of thrips and *Myzus persicae*, Sulz., which were numerous on tobacco in

seed beds, was given by a derris suspension containing 0·02 per cent. rotenone used either as a spray or as a dip in which the seedlings were immersed up to the roots in bundles of 50–100 when they were transplanted. Aleurodids of the genus *Bemisia* appeared to transmit the kroepoeh and krekoh virus diseases. Transmission of D-disease by them and of perforation disease by *M. persicae* has been observed in another part of Java [*R.A.E.*, A **27** 493]; perforation disease also occurs in Besoeki. The Capsid, *Engytatus tenuis*, Reut., was widespread on tobacco, but caused no conspicuous injury to the leaves. It was observed to attack newly hatched larvae of *Prodenia litura*, F. Control measures against the larvae of *P. litura*, *Heliothis assulta*, Gn., and *H. armigera*, Hb. (*obsoleta*, F.) were required throughout the season. A fine spray of 1 per cent. lead arsenate was applied in the seed beds, while the measures used in the field were hand-picking, sprinkling young plants with a 1–2 per cent. suspension of lead arsenate, and dusting older ones with a mixture containing 2·5 per cent. lead arsenate. To avoid spreading virus diseases, the forceps used in picking off the larvae were dipped each time in a 4 per cent. solution of formaldehyde.

Volkonsky (M. A.) & Volkonsky (M. T.). **Rapport préliminaire sur une mission d'étude des acridiens dans le Mouydir et le Tademait (mai-juillet 1939).**—*Arch. Inst. Pasteur Algér.* **17** no. 4 pp. 634–649, 1 map. Algiers, 1939.

In May 1939, the presence of hoppers and adults of *Schistocerca gregaria*, Forsk., in the solitary phase was reported south-east of In-Salah, in the Algerian Sahara, and further surveys showed a general increase in the density of the population of this locust in the central Sahara, especially in the north and west of the Mouydir area. In some places, a second generation was produced and showed signs of transformation into phase *congregans*, but a heavy mortality among the hoppers was caused by heat. Adults of this second generation mixed with those of the first, and loose flights were observed to move along water courses. In the middle of June, the locusts began to disappear, emigrating southwards. These observations tend to suggest the possibility that certain mountainous regions in the central Sahara may occasionally serve as outbreak areas of *Schistocerca*.

Silvestri (F.). **Compendio di entomologia applicata (agraria-forestale-medica-veterinaria). Parte speciale, Vol. I. (parte 2a)** pp. 449–974, 464 figs., 58 pp. refs. Portici, 1939.

This second part of the first volume of this work [*cf. R.A.E.*, A **23** 296] deals with the Aphids not included in the previous part, the Coccids and the Anoplura.

Chevalier (A.). **Sur une invasion de doryphores au Jardin des Plantes et sur les plantes sur lesquelles vivent ces insectes en fin de saison.**—*C. R. Acad. Sci.* **209** no. 12 pp. 468–471. Paris, 1939.

Adults of *Leptinotarsa decemlineata*, Say, were observed in May 1939 feeding on the foliage of hybrid petunias in the gardens of the Museum of Natural History in Paris. As there were no potato plants in the vicinity, it is assumed that the infestation had originated in

1938 from adults brought to Paris in the material used to pack potatoes for transport. On 3rd September 1939, adults of *Leptinotarsa* were observed in the Museum garden on *Solanum villosum*, a weed that was intermixed with *S. nigrum*; the latter was not attacked. Further observations showed that adults were also present on *S. sisymbriifolium*, which was the most severely defoliated, *S. cornutum*, which is known to harbour the beetle in the southern United States, *S. gracile*, *S. incertum*, *Nicotiana rustica*, *N. plumbaginifolia* and *Lycopersicum humboldti*. Tomato was not attacked. As the beetles fed mainly on the lower leaves and neglected the young foliage, shoots and inflorescences, the damage caused was slight.

BRÉNY (R.). **Influence des froids de décembre 1938 sur l'hibernation du doryphore en Belgique.**—*Bull. Inst. agron Gembloux* **8** no. 2 pp. 118–125, 3 figs. Gembloux, 1939. (With Summaries in Dutch, German and English.)

In Belgium, comparatively mild weather during the first fortnight of December 1938 was followed by twelve days of extreme cold, and in this paper an account is given of the effect of these conditions on hibernating adults of *Leptinotarsa decemlineata*, Say [*cf. R.A.E.*, A **27** 584, 622], together with a general consideration of the influence of temperature on the water content of hibernating insects and the various factors that determine the temperature of different types of soil. Tables show the mean temperature in 36 districts during the first fortnight of the month and on 16th and 20th December, and graphs show for the whole month the daily temperature of the atmosphere and of the surface of bare soil and the daily precipitation of rain or snow at two stations in central Belgium.

The lethal temperature for hibernating adults of *L. decemlineata* varies between −4°C. [24·8°F.] and −12°C. [10·4°F.] [**22** 94], and the temperature at the surface of the soil was never lower than −12°C. At the beginning of January 1939, 30 adults, of which 18 were dead, were collected from the top layer of soil in the out-door rearing cages at Gembloux; of these, 9 had died as a result of attack by the fungus, *Beauveria*, 2 were dismembered, and in 7 death was attributed to cold. At depths greater than 2 ins., no mortality occurred. The percentage mortality of the whole hibernating population was 9·33. The snow was prevented from covering the soil in the cages and so afforded no protection from the cold, but as the cages were sunk to a depth of 8–10 ins. in the ground, conditions in them were considered to be typical of the district.

LOUNSKY (J.). **Note sur la résistance des azalées à la fumigation au bromure de méthyle.**—*Bull. Inst. agron. Gembloux* **8** no. 2 pp. 126–131, 6 figs., 1 ref. Gembloux, 1939. (With Summaries in Dutch, German and English.)

In continued investigations on the effect on azalea plants of fumigation with methyl bromide [*cf. R.A.E.*, A **27** 605], plants of 34 varieties were treated in winter, without being removed from their packing (wicker baskets or wooden packing-cases), by vacuum fumigation with methyl bromide at the rate of 40 or 80 gm. per cu. m. for two hours. On the whole, the treatments had no injurious effects on them.

Schneider-Orelli (O.). **Vergleichende Untersuchungen an nord- und südschweizerische Reblausmaterial.** [Comparative Investigations on *Phylloxera* from North and South Switzerland.]—*Mitt. schweiz. ent. Ges.* **27** pt. 12 pp. 584–610, 10 figs., 18 refs. Bern, 1939.

Prior to the occurrence in 1937 in north-western Switzerland (Basle) of *Phylloxera vitifoliae*, Fitch, producing leaf-galls on hybrid grapevines [*R.A.E.*, A **27** 46], the infestation of vines in that region was confined to the roots of European varieties, there being no leaf-galls or any infestation of the roots of American stocks, although it was known that in southern France, western Switzerland and the Ticino (southern Switzerland) galls occurred on the leaves of American vines, and that the roots of the stocks were not always free from infestation. This difference in behaviour in northern and in southern and south-western districts indicates that biologically different races of the Aphid are involved. Some of the most important stocks, such as Riparia × Rupestris 3309, could not be infested with *Phylloxera* from Zürich, either in the field or in the laboratory. Subsequently, however, the leaf-gall form observed in Basle, which had presumably been introduced from Alsace, was also found in Zürich. In addition to producing leaf-galls it infests the roots of American stocks, such as Riparia × Rupestris 3309, and ungrafted hybrids. This race, new to northern Switzerland, infests the vines in the same way as the "southern" race, *vitifoliae*, as characterised by Börner, who distinguishes it morphologically from the "northern" race, *vastatrix*, by its shorter rostral setae.

Work on the Aphid would be assisted in Switzerland if it were possible to distinguish the two biological races by morphological characters, and investigations were therefore begun in 1937 on the value in this respect of Börner's index (obtained by dividing the length of the rostral setae of young larvae by the length of the hind tibia). The material used was obtained from northern Switzerland (mainly Basle) and the Ticino (San Nazzaro), and the results are shown in tables and graphs and discussed in detail. The author concludes that the neogallicolae-gallicolae that occur on hybrid vines in Basle and Zürich have, on an average, rather shorter rostral setae and lower indices than those from Clinton vines in the Ticino. The former resembled race *vitifoliae*, and the latter race *vastatrix*, but as many intermediate forms occurred, it was not easy to divide them into the two morphological groups. The classification of the neogallicolae-radicicolae was complicated by the high average index of individuals from leaf-galls on ungrafted vines in northern Switzerland and by the extremely high averages of some larvae from galls on Clinton vines in the Ticino. Examination of root Aphids showed that the index of individuals from Riparia × Rupestris 3309 was considerably lower than that of race *vitifoliae*, and that of root Aphids from European vines agreed, contrary to expectation, with *vitifoliae*. These results lead to the conclusion that morphological and biological characters do not always agree in the same *Phylloxera* material.

Pieri (A.). **Lotta preventiva invernale contro gli afidi del pesco.** [Preventative Winter Work against Aphids infesting Peach.]—*Note Fruttic.* **18** no. 2 pp. 17–20. Pistoia, 1940.

In the region of Pistoia, infestation of peach by Aphids was very slight in 1937 and 1938, but extremely severe in 1939. The most

important species is *Hyalopterus arundinis*, F. (*pruni*, F.), and there is no relation between the degrees of infestation by it in successive years. The probable severity of infestation cannot therefore be forecast, and the possible economic value of dormant sprays can only be roughly gauged by comparing their cost with estimates for at least 5 years of the cost of summer control measures and the losses suffered. Figures from actual practice are given as an example, and it is concluded that in the case considered winter measures would have been economically justified. The best insecticide is a tar distillate applied soon after leaf-fall, but as its continued use may injure the trees it should be replaced every 2–3 years by a quassia spray applied immediately after blossoming.

DULZETTO (F.) & MUSCATELLO (G.). **Sulla "fetola" delle arance e sulle probabili cause che la determinano (nota preventiva).** ["Decay" of Oranges and its probable Causes. (Preliminary Note)]—*Boll. Accad. Gioenia* (3) fasc. 2 pp. 23–27, 1 pl., 2 refs. Catania, 1939.

A detailed description is given of a type of lesion that is becoming increasingly common on oranges and mandarins in orchards near Catania, in Sicily. In one orchard, affected fruits were observed to be heavily infested by Jassids of the genus *Empoasca*, and it is suggested that the punctures caused by their feeding might be responsible for the injury.

[OSMOLOVSKIĬ (G. E.).] **Осмоловский (Г. Е.). Phenological Indicators of the Vegetation as Factors in Planning the Control of Insect Pests.** [*In Russian.*]—*Mitt. Kirov forsttech. Akad.* no. 54 pp. 46–54, 1 graph, 2 fldg tables, 16 refs. Leningrad, 1939.

The author emphasises the importance in the control of insect pests of applying treatment at the correct dates, since in many cases the possibility of control is closely related to a certain stage in the development of the pest. It is usual in work against forest pests in Russia to apply control measures at fixed dates, when the pests may be supposed to be in the susceptible stage, but this is undesirable, as observations have shown that there is considerable variation from year to year in the dates on which plants reach given phases of development, depending on the weather. The dates at which treatment should be applied would be much better determined phenologically, and investigations were, therefore, carried out in the spring and summer of 1936 and 1937 in a mixed forest some 40 miles south-west of Leningrad on the degree of synchronism between the seasonal occurrence of different stages of a number of common insect pests and the various phases of development of the surrounding vegetation. The plants observed comprised 27 species, and 7 species of insects were observed in both years and 10 additional ones in 1937. The results are given in tables showing the phases of plant development that coincided with the incidence of the oviposition period, the larval and pupal stages and the emergence of the adults of the different pests. The occurrence of the developmental stages of some of the insects coincided with the same vegetational phenomena in both years, but further studies on the subject are required.

[Kushev (V. L.).] **Кушев (В. Л). An Experiment in the aviochemical Control of the Pine Geometrid in the Ural.** [*In Russian.*]—*Mitt. Kirov forsttech. Akad.* no. 54 pp. 55–65, 1 graph, 1 fig., 7 refs. Leningrad, 1939.

In 1934, pine forests near Chelyabinsk, in the south of the Ural Province, were severely infested by the pine Geometrid [*Bupalus piniarius*, L.], and 15 pupae per sq. yard of ground were found in the autumn and in the following spring [*cf. R.A.E.*, A **20** 311]. Observations in August 1935 showed that the number of larvae per tree varied in different parts of the forest from 10 to 808 and that the infestation extended over some 925 acres ; about a third of this area was dusted from an aeroplane with calcium arsenite, mixed with a diluent to avoid injury to the trees and applied at the rate of 3·6–4·5 lb. per acre. Experience showed that dusting was best carried out on calm clear days between about 3 and 8 a.m. and in the evening when the wind dropped, or at any time on dull days, provided that there was no rain or wind. In order to secure an even distribution of the dust, the aircraft should fly at a height of not less than 16 or more than 80 ft. above the crowns of the trees. The percentage mortality was estimated by counting the dead larvae that fell to the ground under certain trees after dusting, and by cutting off all the branches from these trees and counting the dead and live larvae on them, or by counting the living larvae on the branches of comparable trees cut off before and 4–5 days after dusting. On an average, only 50 per cent. were killed, probably because the effectiveness of the treatment was decreased by heavy rain that lasted several hours and washed off the poison. Further observations showed, however, that many larvae died later, and that in November the average number of pupae per sq. yard was less than 2.

Cherian (M. C.) & Subramaniam (C. K.). **Studies on *Scirpophaga rhodoproctalis* Hamps.—the White Moth Borer of Sugarcane in South India.**—*Proc. Ass. econ. Biol.* [*India*] **5** pp. 1–6, 1 pl., 11 refs. Coimbatore, 1938.

An account is given of work on the life-history of *Scirpophaga rhodoproctalis*, Hmps., which is one of the most important insect pests of sugar-cane in Madras. Signs by which infestation by this Pyralid can be identified are described, and its distribution is discussed from the literature. The adults are sluggish and short-lived. The eggs are laid in small masses on the under surface of the lower leaves of very young canes, and in prominent long oval batches, usually near the mid-ribs, on the leaves of older ones. One mass may contain 9–79 eggs. The larvae hatch in 6–11 days, and shortly afterwards spin threads, by means of which they scatter to surrounding shoots. Though many larvae may enter the central whorl of leaves, only one of them gives rise to an adult. From the base of the whorl they burrow to the inner heart leaf, invariably after mining the mid-ribs of a few of the leaves. Pupation occurs in a specially constructed tunnel in the stem. The larval and pupal stages lasted 25–42 and 12–21 days. The feeding of the larvae causes dead hearts and, if the growing point is attacked, secondary tillering in young canes and a condition similar to bunchy top in older ones. Infestation is confined to a few shoots round that on which the eggs were laid, and may occur as early as 45–50 days after the germination of the seedling.

The eggs were parasitised by *Telenomus rowani*, Gah., and *Tetrastichus* sp., and the larvae by *Glyptomorpha* (*Stenobracon*) *nicevillei*, Bingh. [*R.A.E.*, A **26** 408], *G.* (*S.*) *deesae*, Cam., *Rhaconotus scirpophagae*, Wlkn. [**26** 602], an undescribed species of the same genus, *Elasmus zehntneri*, Ferrière, *Goniozus* sp. and *Shirakia* sp. Larvae and pupae were destroyed by ants of the genus *Monomorium* and the adults by spiders. Control measures comprise the collection of adults and eggs, and the destruction of infested canes.

In a concluding note, the author points out that there has been great confusion as to the identity of the species of *Scirpophaga* that occur on sugar-cane in India, and that they cannot be differentiated, as had been supposed, by the presence or absence of a black dot on the forewing. There are at least two species, *S. nivella*, F. (*auriflua*, Zell.) and *S. rhodoproctalis*, distinguishable by the male genitalia and the colour of the anal tuft of the female. The identity of *S. monostigma*, Zell., is uncertain, and *S. rhodoproctalis* may eventually prove to be a synonym of it. Specimens of the species dealt with in this paper were submitted to W. H. T. Tams, and all were identified as *S. rhodoproctalis*.

Vesey-Fitzgerald (D.). **Entomology.**—*Rep. Dep. Agric. Seychelles 1938* pp. 14–16. Victoria, Seychelles, 1939.

The introduced Coccinellid, *Chilocorus distigma*, Klug, continued to give satisfactory control of *Ischnaspis* [*longirostris*, Sign.] and *Chrysomphalus ficus*, Ashm., on coconut in the Seychelles [*cf. R.A.E.*, A **27** 335] in 1938 and showed promise of checking *Pinnaspis buxi*, Bch. Figures are given showing the percentages of coconut leaves with severe, medium or light infestation by *Ischnaspis* in a number of localities before and after the introduction of the predator. *Exochomus ventralis*, Gerst., and *E. flavipes*, Thnb., have proved very useful against Lecaniine scales on coconut, and there was a noticeable decrease on some plantations in the abundance of *Eucalymnatus* (*Lecanium*) *tessellatus*, Sign., and of the sooty mould associated with it. A shipment of *Chilocorus angolensis*, Crotch, was received, and liberations were made against Lecaniine scales, but the Coccinellid has not become established. The black ant, *Technomyrmex detorquens*, Wlk. (*albipes*, F. Sm.), has become less abundant where the predators have reduced the scales. A consignment of *Rodolia* (*Vedalia*) *cardinalis*, Muls., which is predacious on *Icerya seychellarum*, Westw. [*cf.* **26** 433], was received late in the year and was successfully bred in the laboratory. Coccids of the genera *Vinsonia* and *Ceroplastes* were not attacked by the introduced predators and continued to damage *Eugenia* spp., mango and avocado. An oil emulsion has given promising results against them.

The Lymexylonid beetle, *Melittomma insulare*, Fairm., continued to be a major pest of coconuts [*cf.* **26** 433] ; mechanical measures proved too expensive for general application. Minor pests identified during the year included *Coptotermes truncatus*, Wasm., which damaged the woodwork of houses and bored into living wood of *Eucalyptus citriodora*, the Tettigoniid, *Gryllacris sechellensis*, Bol., which attacked cloth and paper, the Derbid, *Proutista moesta*, Westw., on sugar-cane, *Pyrausta phoenicealis*, Hb., which fed on the leaves of Japanese peppermint [*Mentha arvensis* var. *piperascens*], and the Rutelid, *Adoretus versutus*, Har., adults of which fed at night on various plants.

DU PLESSIS (C.). **The incipient Outbreaks of the Brown Locust in 1937–38, with special Reference to biometrical Analysis.**—*Sci. Bull. Dep. Agric. S. Afr.* no. 209, 69 pp., 2 maps, 6 graphs, 12 refs. Pretoria, 1939. Price 6*d*.

After the last large-scale outbreak of *Locustana pardalina*, Wlk., in the Union of South Africa terminated in 1935, there were no incipient outbreaks of this species until the early summer of 1937–38, when they were reported in four districts of Cape Province. After the completion of the first generation, extensive incipient outbreaks were reported in many parts of the Union and in southern South-West Africa, and by the end of March 1938 the infestation had spread over an area of nearly 13,000 sq. miles. The regions involved were within the known outbreak areas of *L. pardalina* [*cf. R.A.E.*, A **26** 684]. In spite of the extensive use of poison baits, many hoppers had reached the adult stage by mid-March, and formed swarms that moved eastwards. To protect the eastern grain-producing districts, the swarms were controlled by means of baits, and 80 per cent. of the adults had been destroyed by the end of May. There were, however, numerous egg-deposits, and an extensive anti-hopper campaign had to be carried out in the summer of 1938–39.

A detailed biometrical study was made of examples of *L. pardalina* belonging to different phases. It was found that phase *gregaria* can be differentiated from phases *solitaria* and *congregans* by means of the E/F ratio (obtained by dividing the length of the elytron by that of the hind femur), which, however, cannot be used to differentiate between the two latter. In phase *solitaria*, however, the males are only about 75 per cent. as large as the females ; whereas in *transiens congregans* and in *gregaria* they are 85 and 97 per cent. as large, respectively. Hence sexual dimorphism, expressed by the ratio of the mean length of the elytron in females over that in males, is a fairly accurate indication of the phase. The morphological differences between groups of adults belonging to five successive generations taken in 1936–37 and 1937–38 in the Middelburg outbreak area were erratic and did not show any regular trends, in spite of the fact that the density of the successive generations of hoppers must have increased progressively. The adults taken at the end of the 1936–37 season in many areas where incipient hopper bands appeared in the following season all belonged to phase *solitaria*.

During the field surveys carried out in 1936–37, no evidence of incipient outbreaks could be found in the major outbreak areas, although the population of phase *solitaria* had increased considerably. A study of the weather conditions for 1935–36, 1936–37 and 1937–38 [*cf.* **27** 93–94] showed that in almost all districts seven or more generations could have been completed during these three seasons. The exceptions were the Prieska and Kenhardt districts, where only five and three generations, respectively, were possible. It follows that about 75 per cent. of the incipient outbreaks recorded in the 1937–38 season originated from the gradual increase of local populations of phase *solitaria*. In the Kenhardt district, they may have been due to infiltration of locusts from South-West Africa, or to a higher initial population of phase *solitaria*.

It is concluded that the method of preventive control, which is based on the principle that outbreaks of phase *gregaria* can be forestalled by prompt destruction of incipient concentrations in outbreak

centres, failed against *L. pardalina*, for it was not possible to prevent the formation of swarms of phase *gregaria* and the invasion of regions outside the outbreak area. The breakdown of preventive control was due to the immensity of the area involved in the incipient outbreaks and the large percentage of hoppers that remained scattered outside the migrating bands and could not be destroyed. Finally, even when the bands were sufficiently dense for bait to be used, they consisted of hoppers of different instars, and as no food is taken during ecdysis, many hoppers escaped poisoning and attained the adult stage. It is stressed, however, that control of large and uniform migrating bands is essential, as otherwise the resultant swarms would seriously threaten agricultural areas.

ANDREWARTHA (H. G.). **The Small Plague Grasshopper (*Austroicetes cruciata* Sauss.). Notes on the present Position in South Australia and Recommendations for Control Measures.**—*J. Dep. Agric. S. Aust.* **43** no. 2 pp. 99–107, 6 figs. Adelaide, 1939.

The life-history and distribution of *Austroicetes cruciata*, Sauss., in South Australia are discussed [*cf. R.A.E.*, A **26** 583–584], and the years of major outbreaks of this species enumerated [**26** 111]. An outbreak occurred in 1938, and as the eggs were not greatly affected by the very hot and dry summer conditions, another was expected in 1939.

A. cruciata never oviposits in soft sand or ploughed ground, but only in compact soils such as are found on pastures, roadsides, stock routes and headlands [*cf.* **26** 703]. It is, however, a pest of both pastures and crops, for after the spear and barley grasses and trefoil, which are preferred, are eaten or dry off, it may migrate to wheat-fields, where it may completely destroy the young crops and considerably damage the older plants.

The young hoppers show no definite tendency to gregariousness, but when they reach the fourth or fifth instar, they sometimes mass into bands and migrate over short distances. The adults are only weakly gregarious. They may drift about the countryside for distances up to 10–15 miles from the breeding ground, but there is no definite migratory movement. The eggs are attacked by the Bombyliid, *Cyrtomorpha flaviscutellaris*, Roberts [**26** 629], which may destroy up to 30 per cent. of them, *Scelio chortoicetes*, Frogg., and the larvae of an unidentified beetle.

Control must be organised on a community basis and directed against the hoppers, which should be poisoned with a bait prepared by moistening 24 lb. bran with a solution of 8 oz. sodium arsenite and 4 lb. molasses in 3 gals. water, and distributed early in the morning or late at night in front of a band, at the rate of 20–30 lb. per acre. As an alternative, the infested area may be sprayed with a solution of 1 lb. arsenite and 2 lb. molasses in 16 gals. water, but this spray scorches the foliage and renders the plants poisonous to stock. The mechanical control methods usually employed against grasshoppers may be locally effective.

CALDWELL (N. E. H.). **Bean Fly Control in southern Queensland.**—*Qd agric. J.* **52** pt. 4 pp. 393–396, 8 figs. Brisbane, 1939.

Agromyza phaseoli, Coq., has been known as a pest of beans in Queensland for many years, and is probably indigenous there. In the

coastal areas it has been largely responsible for the restriction of bean cultivation to the cooler months of the year, and even then serious losses have sometimes been experienced. The first sign of acute infestation in young plants is a characteristic drooping of the first two leaves. If the plants survive, the stems burst at or just above ground level, where the larvae and pupae concentrate, and large calloused areas develop. When the growing conditions are good, however, the plants may develop secondary roots at or above the calloused part and recover sufficiently to bear a crop. If the attack is slight, the plant may not show any external symptoms. In older plants, infestation is usually accompanied by a discoloured swelling at the leaf joints ; this appears to have little effect on cropping capacity, but the plants are liable to be damaged by wind and to break during picking operations.

Infestation probably occurs throughout the year, but the damage is normally considerable only during the warmer months of the bean season. Both early crops, planted in January and February, and main crops, planted in March, April and May, are infested, but the attacks usually diminish towards the end of May and are of little importance in later sowings, except in a mild winter. If there are no bean crops in spring, the population remains low until planting begins in January and February, and then increases rapidly, so that mid-season crops are liable to severe attack. If beans are planted all the year round, early crops may suffer as severely as those planted in mid-season.

The life-history of the fly is similar to that observed in New South Wales [*cf. R.A.E.*, A **26** 335], and the spray of white oil and nicotine sulphate there recommended is also effective in Queensland. Applications should be made three days after the beans first appear above ground and thereafter at intervals of four days. The number of applications depends on the time of year, the prevalence of the fly, the incidence of damage elsewhere in the district, and the rate at which the crop is growing. Beans planted in the middle or at the end of summer usually require 4–6 applications, and those planted in autumn and early winter 2–4. About 30–50 gals. spray per acre should be applied thoroughly to the upper surface of the leaves. The spray kills the eggs and young larvae in the leaves but not the older larvae, and the residue on the leaves repels the adults for at least 24 hours and may affect eggs laid within 48 hours after spraying. If small areas are planted at intervals of about a fortnight throughout the main season, the young plants can be protected by sprays in turn, the older plants being much less susceptible to damage when the spray schedule is completed. Slight scorching of the leaves may occur, but is of no importance. If rain falls soon after spraying, the kill of eggs and larvae may be considerably reduced, and an extra application may be advisable. Proper cultural methods, and particularly earthing up the plants, are important, as vigorous rapidly growing beans are able to withstand attack better than slow growing plants. Fresh spray should be prepared for each day's application, as the mixture deteriorates rapidly if left in open containers.

PEMBERTON (C. E.). **31-1389—Its Susceptibility to Insect Attack in Hawaii.**—*Hawaii. Plant. Rec.* **43** no. 4 p. 254. Honolulu, 1939.

The sugar-cane variety 31-1389 has exhibited no special susceptibility to attack by any of the insect pests of sugar-cane in Hawaii. It was noticed that it remained unusually free from the cane aphis [*Aphis*

sacchari, Zehnt.] and associated sooty mould during seasons when other varieties in the same locality were affected. It is less damaged by beetle borer [*Rhabdocnemis obscura*, Boisd.] than the variety POJ 2878 and is at least equal to H 109 in this respect. Although its rind is softer than that of H 109, its self-stripping habit and slower growth in the second season seem to give it a better resistance to borer attack than is possessed by other varieties equally soft [*cf. R.A.E.*, A **26** 614, 741].

SCARONE (F.). **Quelques plantes vénéneuses américaines et asiatiques aux propriétés insecticides.**—*Agron. colon.* no. 258 pp. 174–185; no. 259 pp. 13–18. Paris, 1939.

Annotated lists are given of plants in the Far East and North and South America that have poisonous properties and are or might possibly be used as a source of insecticides.

TUCKER (R. W. E.). **Cotton Growing and Cotton Pests Control.**—*Agric. J. Barbados* **8** no. 1 pp. 3–7, 3 refs. Barbados, 1939.

Before the pink bollworm (*Platyedra gossypiella*, Saund.) became established in Barbados, cotton was usually planted in June and allowed to remain on the land for about 11 months; large yields were obtained, and picking was carried out over a considerable period. Since 1928, however, the growing of cotton has been regulated; a close season of over a year was instituted in 1928–29, the date of planting in subsequent years was fixed for about 1st September, when the maximum rains are normally over, and fields have to be cleaned of cotton by the end of April. For various reasons, the minimum close season of 4 months was not always obtainable [*cf. R.A.E.*, A **25** 42], and the incidence of the bollworm subsequently increased. These restrictions, and the consequent coincidence of cotton picking with the sugar-cane harvest, resulted in a decrease in the cultivation of cotton. The shorter growing period also made it more imperative to control leaf-eating insects, such as *Alabama* (*Aletia*) *argillacea*, Hb., and *Laphygma* (*Xylomyges*) *eridania*, Cram., as any severe defoliation delays the fruiting of the cotton. They are not, however, well controlled by the local practice of dusting with Paris green and lime after the plants have already been attacked. If dusting is delayed, even for a very brief period, flowering and bolling are retarded and infestation by *P. gossypiella* is increased. It is considered, therefore, that dusting should be replaced by spraying with lead arsenate mixed with molasses as an adhesive [*cf.* **27** 661]. Sprays are more resistant than dusts to rain, and can, therefore, be applied before defoliation is observed. Also, lead arsenate does not scorch the plants as Paris green sometimes does. Efficient portable compressed-air sprayers and stocks of lead arsenate are now available in Barbados.

The close season for cotton is associated with a controlled season for okra, *Hibiscus esculentus* [*cf.* **27** 661], which is largely grown in small holdings. The okras are inedible if picked later than three days after the flowers have withered, and if they are then left on the plants until used as food for stock, they may harbour the larvae of *P. gossypiella* [*cf.* **28** 44, 216]. Field collections and records have shown that in Barbados the larvae can survive in the field for four months in fallen cotton bolls or lint. Destruction of cotton residues is, therefore,

essential, and the present practice of allowing the bushes to dry and burning them in the fields should be continued, accompanied by the collection of all fallen bolls and lint.

TUCKER (R. W. E.). **The Control of** *Diaprepes abbreviatus* **L. and** *Lachnosterna* (*Phytalus*) *smithi*, **Arrow, in Barbados surveyed over a Period of Eleven Years.**—*Agric. J. Barbados* **8** no. 1 pp. 8–18, 17 refs. Barbados, 1939.

The damage caused to sugar-cane in Barbados by *Diaprepes abbreviatus*, L., and *Lachnosterna smithi*, Arr., is discussed; under the conditions prevailing in the Island both are practically specific to sugar-cane, owing to the lack of alternative food-plants or breeding grounds. *D. abbreviatus* is the more harmful, as the larvae feed on the root system and later bore into the subterranean parts of the stems, and also attack germinating seed cane. In some parts of Barbados, this borer is still confused with another weevil, *Metamasius sericeus*, Ol., which is a less important pest of sugar-cane [*cf. R.A.E.*, A **19** 720]; brief descriptions of the adults of the two species are therefore given.

Measures for the control of *D. abbreviatus* and *L. smithi* are briefly reviewed. None of the parasites introduced against them has become established [*cf.* **24** 606]. Large-scale experiments with soil fumigants and contact insecticides against the larvae showed that the labour entailed and the cost were prohibitive, and the percentage mortality obtained was never as much as 50. It was also found that the soils of Barbados are too heavy and impervious to warrant soil treatments.

The measures advocated are cultural methods, such as digging up and splitting cane stumps, ploughing and forking fields; building artificial pools for rearing the toad, *Bufo marinus*; and hand collection of the adults. The results of organised collections for the period 1929–38 are shown in tables. The maximum numbers recorded were over 250,000 egg-masses of *Diaprepes* in 1930 and 8 million adults in 1931, and over 8 million adults of *Lachnosterna* in 1936. Criticisms of the method are examined, and it is shown to be effective and economic. The organised voluntary system adopted is briefly described. The practice of planting pigeon pea, *Cajanus cajan* (*indicus*), in strips round cane fields (the average size of which in Barbados is 5–6 acres) is of great value if the beetles are collected, as this crop attracts them in large numbers from within the cane field. Spraying the pigeon peas would not be effective against the adults of *Diaprepes*, as they avoid sprayed vegetation, and would be uneconomic against *Lachnosterna* in view of its wide range of food-plants.

CRAIGHEAD (F. C.) & ST. GEORGE (R. A.). **Experimental Work with the Introduction of Chemicals into the Sap Stream of Trees for the Control of Insects.**—*J. For.* **36** no. 1 pp. 26–34, 16 refs. Washington, D.C., 1938. [Recd. 1940.]

The authors briefly review the history of the treatment of trees for various purposes by introducing chemicals into the sap stream and discuss the results of work in the United States in the last 10 years on the development of this method for the control of bark-beetles and the prevention of infestation by insects of certain forest products. It is desirable that the chemicals to be used should serve not only as good insecticides but also as wood preservatives. The method has shown great promise, but has not been completely successful under all conditions tested.

The usual practices in the control of bark-beetles are to fell the tree and burn it and to remove or burn the bark. Infested trees are often so severely injured within about a week of attack that they cannot recover, and as in either case the death of the tree is inevitable, the work has been directed to killing the pest to check the spread of infestation and to preserving the timber from decay. The technique employed was either to cut off young trees and stand them in the solution, or to introduce it into standing trees. Both deciduous and coniferous trees have been treated. In all cases, the tree should be green and its crown intact. It was necessary to introduce the solution round the entire circumference of the trunk in order to obtain adequate and uniform distribution to all parts of the stem and crown. In the case of standing trees, a ring of bark was removed round the base of the trunk, a notch was sawn round through several annual rings, a wide rubber band, fastened with staples, was stretched round it, and the solution was allowed to flow into the notch from a container suspended above it. Only enough water to dissolve the poison was necessary. Absorption of 1–2 gals. solution took 1–3 hours on sunny days and up to 24 hours on cloudy or cool days. Green healthy conifers could be treated at any time except during frost, but absorption was quicker during the growing season. The hardwood trees absorbed the poison readily only during the active growing season. The trees should be left for 5–10 days after the liquid is absorbed to allow for thorough distribution of the solution. Zinc chloride and copper sulphate were the most satisfactory of the chemicals tested, both for bark-beetle control and for the protective treatment of trees of which the timber was to be used for posts, etc., in contact with the ground. Some of the organic compounds were not readily introduced into the sap stream, and the chemicals that act as fumigants and the alcohols, though temporarily effective, were of no value as wood preservatives. Sodium arsenite, sodium arsenate and mercury bichloride gave good control of insects and preserved the wood, but left residues poisonous to man. The use of this treatment against bark-beetles is complicated by the blue-stain fungi that they introduce. These develop in the sap-wood and interfere with the conduction of the chemical solution through the tree. The method is therefore ineffective unless the poison is distributed before the fungi develop. It is thus impracticable in the southern United States, where the fungi develop in short-leaf pine [*Pinus echinata*] within 5–7 days of attack by the southern pine beetle [*Dendroctonus frontalis*, Zimm.]. In Idaho and Montana, however, successful control of the mountain pine beetle [*D. monticolae*, Hopk.] in white pine [*P. monticola*] was obtained for 60–90 days after attack.

This method of treatment has also been tried for the control of insects infesting the bark or leaves of valuable shade and ornamental trees, but no chemical has been found that kills the insects without injury to the trees.

BEDARD (W. D.). **Control of the Mountain Pine Beetle by means of Chemicals.**—*J. For.* **36** no. 1 pp. 35–40, 2 figs., 1 ref. Washington, D.C., 1938. [Recd. 1940.]

Investigations on the control of *Dendroctonus monticolae*, Hopk., by means of chemicals introduced into the sap stream of infested living pines were carried out on *Pinus contorta* in Montana in 1926–30

and on *P. monticola* in eastern Washington from 1930 onwards. The method of injection [*cf.* preceding abstract], the organisation of the labourers and their equipment are described in detail, and a list of the chemicals tested is given. Powdered copper sulphate was the cheapest, the most efficient and the easiest to handle, and gave successful results in *P. monticola* when 8 oz. powder in 3 U.S. quarts water was used per tree. The band or collar round the notch to which it was applied was of rubber sheeting and stretched sufficiently to contain the whole of the amount required. The treatment should be carried out in late summer or autumn, as it is not successful more than 90 days after infestation begins, owing to the development of blue-stain fungi.

Comparison of the chemical method of control with burning or barking the tree, carried out during 1933–36, showed that at a time when bad weather was unlikely to interfere with the work, labourers could treat about three times as many trees per day by the chemical method as by the others at about two-thirds of the cost per tree. Chemical injection is approximately 95–99 per cent. effective. Burning is not completely effective, as some bark is often left unburnt, and it is dangerous when the forest is dry ; peeling the bark is still less effective as the adults are not destroyed. Moreover, chemical treatment, unlike the other methods, does not destroy beneficial insects, which are killed only in the few cases in which they have not completed their feeding. The dead trees left standing after chemical treatment are a disadvantage, which is, however, compensated for if they can be preserved in such a condition that they can be harvested several years later.

WYGANT (N. D.). **The Relation of Insects to Shelterbelt Plantations in the Great Plains.**—*J. For.* **36** no. 10 pp. 1011–1018, 4 figs., 1 ref. Washington, D.C., 1938. [Recd. 1940.]

The trees in shelter-belts and farmstead plantings in the Great Plains region of the United States make good growth in years of average or high rainfall, but may become weakened during unfavourable years and killed by borers or leaf-eating insects during periods of severe drought. The recent period of drought began in 1934, the rainfall deficiencies (at Lincoln, Nebraska) in that and the three following years being 37, 7, 49 and 28 per cent. During a three years' study of insects in the Great Plains, begun in 1935, grasshoppers were found to be the most important defoliators, as they sometimes caused the trees to die in a single year, particularly those newly planted. In addition to feeding on the leaves, they sometimes chew off the green bark. Infestation by the Geometrid, *Paleacrita vernata*, Peck, in Nebraska and Kansas has weakened many American elms (*Ulmus americana*), thus rendering them susceptible to the Buprestid, *Chrysobothris femorata*, Ol. Injury by Sphingid larvae to the older plantings of green ash (*Fraxinus lanceolata*) in Nebraska and South Dakota has been severe. The most serious damage, however, is caused by borers, infestation by which is favoured by the weakening effect of the drought, which greatly complicates their control. Practically no species of tree is immune from attack at any stage of growth. Transplanted trees are attacked by *C. femorata* until the root systems become well established, as also are older trees that are weakened by drought. The Lamiid, *Plectrodera scalator*, F., has made the establishment of poplar (cottonwood) very difficult in certain sections of Oklahoma

and Kansas. The larvae hollow out the bases of young trees, which either break off in the wind or die from lack of conduction. Other common borers are the Cossid, *Prionoxystus robiniae*, Peck, and the Cerambycid, *Tylonotus bimaculatus*, Hald., on *F. lanceolata*, the Cerambycid, *Cyllene robiniae*, Forst., on black locust (*Robinia pseudacacia*) and the Buprestid, *Agrilus difficilis*, Gory, on honey locust (*Gleditschia triacanthos*). All of them, except possibly *P. scalator*, cause most damage on dry sites, but during the recent drought, they killed some of the native trees on moist sites in the ravines.

A severe outbreak of *C. femorata* occurred to the west of Lincoln, Nebraska, during 1937. Its numbers had been increasing since the beginning of the drought in 1934, but this was the first occasion on which defoliation by the adults had been observed. The beetles did not feed on the blades of the leaves, but chewed off the bases of petioles, causing the leaves to fall. The injury was most severe about 1st July, and by 15th July many trees were completely defoliated. In several areas the buds were chewed off and the green bark was eaten from the young branches. The trees most severely injured were *U. americana*, cherry, pear and pin oak (*Quercus palustris*). Injury to apple, willow and Russian olive (*Elaeagnus angustifolia*) was only slight, and a number of other trees were almost immune, though they were occasionally injured when no preferred food-plants were near. The beetles are strong flyers, and several defoliated trees were observed at least a quarter of a mile from any possible source of infestation. Emergence holes were present on many trees, including species on which the adults fed very little. Orchards sprayed with lead arsenate as part of the yearly spray programme were not injured, but unsprayed ones were completely defoliated. The relation of this outbreak to weather conditions and of the injury it caused to tree growth is discussed. The numbers of the beetle increased during the years of deficient rainfall and very high summer temperatures, and in 1936, when the drought was most severe, a very large population was built up, resulting in a heavy emergence of adults in June 1937.

Lexen (B. R.). **An Experiment in the Use of Sodium Arsenite in thinning Ponderosa Pine.**—*J. For.* **37** no. 3 pp. 259–262. Washington, D.C., 1939.

Experience in the United States in recent years has shown that thinning forests by poisoning undesirable trees with sodium arsenite introduced into the sap stream has the advantage that trees killed in this way have resisted or escaped damage by Scolytids of the genus *Ips*, which usually attack felled trees. The common wood borers have entered the wood a year after the poisoning, but have preferred strips along the bole that were not stained by the ascent of the poison in the tree. If, in addition, the pruning of the other trees is confined to dead limbs, no fresh slash will be produced, and the danger of attracting insects from other parts of the forest will be avoided. The dead standing trees will act as a supporting structure for the living ones, which, under normal conditions, are often bent over and broken by snow during the winter after thinning.

An account is given of an experiment carried out in June 1936 on 300 trees marked for thinning in a group of ponderosa pine [*Pinus ponderosa*] of uniform age and with a diameter of less than 14 ins.

to determine the approximate amount of sodium arsenite required, an efficient method of application and the behaviour of different concentrations of poison. Holes $\frac{3}{4}$ in. in diameter and 5 ins. deep, which sufficed to hold 25 cc. of poison solution, were bored at an angle of 45° towards the centre of the bole or tangentially just within the bole through the two or three outer annual rings, on one, two or four sides of the tree. Poison applied in the central holes did not appear to take effect so rapidly as that in the others, though the ultimate effectiveness was the same. It is considered that the difference would be greater in older trees in which more differentiation of sapwood and heartwood had taken place. There was evidence that the application in each of two holes per tree of 25 cc. of sodium-arsenite solution containing 4 gm. arsenic trioxide is ample to kill trees of a diameter of up to 12 ins.

BALDWIN (H. I.). **The European Spruce Sawfly in New Hampshire 1938.**—*J. For.* **37** no. 11 pp. 876–878. Washington, D.C., 1939.

Gilpinia (*Diprion*) *polytoma*, Htg., was observed on spruce in New Hampshire for the first time in 1929, and by 1935, light infestations were generally distributed. In August 1937, heavy local infestations were found, and the area covered by these increased in 1938 [*cf. R.A.E.*, A **26** 487; **27** 369]. Infestation was most severe in the southern highlands, and it was estimated that 5 million board feet of spruce would die within 3–5 years. The methods by which the infestation was investigated are described, and the possibility of control by introduced parasites is discussed. In the autumn of 1937, a consignment of the pupal parasite, *Microplectron fuscipenne*, Zett., was received from the laboratory at New Haven, Connecticut, where this Eulophid had been received from Canada, and liberations were made in New Hampshire. Some recoveries were obtained in the following spring. In the summer of 1938, about 930,000 of *M. fuscipenne* from New Haven were released in 38 colonies, and about 12,000 of the Ichneumonid, *Exenterus abruptorius*, Thnb., from Canada were released in 2 places. Other parasites liberated included *E. oleaceus*, Uch., and *E. tricolor*, Roman.

MCINTYRE (H. L.). **Report on Forest Pest Problems in New York.**—*J. For.* **37** no. 11 pp. 879–883. Washington, D.C., 1939.

Several insects have become important as forest pests in New York State in recent years. Infestation of balsam fir [*Abies balsamea*] by *Chermes* (*Adelges*) *piceae*, Ratz., is general and very heavy in the southern Adirondacks, and since outbreaks were found in the Catskills and in Rensselaer county in October 1937, it is likely that it is more widespread than has hitherto been believed. It is not known to occur on any tree but *A. balsamea*, which it injures by sucking the sap, principally from the body of the tree, and by causing swellings or cankers on the branches [*cf. R.A.E.*, A **21** 283]. Several outbreaks of *Dendroctonus piceaperda*, Hopk., have occurred in the Adirondack and Catskill districts, and this Scolytid is probably present on over-mature spruce throughout New York. Damage is limited to such trees, but is quite extensive. The presence of the beetle is not easily detected in the initial stage of attack, but the infested trees soon begin to shed their leaves, and in well-advanced infestations they turn a reddish brown

colour, owing to the scaling of the bark by woodpeckers that extract the larvae for food. Small pitch tubes and round holes in the bark are further evidence of infestation. The author considers that outbreaks of these two insects are of less importance than is usually believed. Good forest management both prevents and controls infestations. It is recommended that infested timber should be salvaged at the time of infestation, when it is more valuable than it is a few years later.

Serious outbreaks of the Cercopid, *Aphrophora parallela*, Say, have occurred only in the Hudson Valley region ; infestation by it can be recognised in early summer when the nymphs produce quantities of froth, which may entirely cover large numbers of trees, but there are no other outstanding symptoms of attack. It may kill large areas of trees and caused serious injury to Scots pine [*Pinus sylvestris*] in 1935–38, particularly in two localities in the south-east of the State, where practically all the trees more than 20 years old were killed. Other species of pine were infested but rarely injured, even when growing with severely injured Scots pine. The population of *A. parallela* fluctuates, apparently in cycles of 9 years, and it probably reached its peak in 1936 or early 1937 ; its numbers were suddenly and drastically reduced by a fungous parasite in July 1938. No practicable direct method of control for forest plantations was found, and the results of silvicultural control by means of early thinning are not yet known. Damage is confined to plantations more than 15 years old, and is usually concentrated in the centre of the plantation.

Gilpinia (*Diprion*) *polytoma*, Htg., probably occurs in New York wherever spruce is prevalent, and though it may prefer red, black or white spruce [*Picea rubra, P. mariana* and *P. glauca*], it probably thrives on any native or exotic spruce. It has been observed in New York since 1931, but no commercial damage has yet been noted. The two most severe outbreaks occurred in widely separated areas in plantations of Norway spruce [*P. abies*] and of Norway and white spruce, in both of which heavy feeding was observed on a few trees. Pine sawflies of one species or another are scattered over the whole State, and each outbreak causes a certain amount of damage. Outbreaks have occurred only in plantations, and the most severe have been limited to red pine [*Pinus resinosa*]. The total damage caused has been considerable, and there is an alarming annual increase in the number of outbreaks. If future plantings are properly mixed, however, there should be little damage from sawflies.

Lymantria (*Porthetria*) *dispar*, L., is potentially a serious forest pest in New York, as it feeds on almost all the native trees, whatever their density or age. It was formerly spreading westward from the New England States at the rate of 6 miles or more a year, but its progress has ceased since the institution of the barrier zone [*cf.* **11** 301]. During the 15 years in which this has been maintained, outbreaks have been treated in all the counties bordering on the New England States from Essex to the Bronx, and in two on Long Island and two west of the Hudson River. The cost of keeping the moth from becoming permanently established in New York, when compared with the success of the campaign, is shown not to have been unduly high. Control of the white pine weevil [*Pissodes strobi*, Peck], which is almost as serious a forest pest as *L. dispar*, appears to be effective if the treatment is properly carried out, but many more trees per acre have been treated than is necessary. Dense planting

gives partial control, and mechanical control [*cf.* **19** 453] is necessary only until the canopy closes, after which damage by the weevil is of little importance and can be dealt with by proper forest management. If suitable mixtures are used in future plantings, the necessity for control will be greatly reduced. In a reforested area in New York, the average number of infestations per acre during three years was 1·3 in plantations and 5·6 in natural stands.

The pine-shoot moth, *Rhyacionia buoliana*, Schiff., which suffered very high mortality in the cold winter of 1934–35, is increasing in numbers again. It can be destroyed by removing the infested buds or by spraying, but both methods are too expensive for use on any but ornamental pines. No further treatment is necessary if the moth is kept out of forest stands until they are 15–25 years old, the age depending on the vigour of the trees. This is not difficult if zones free from infestation are maintained round young stands until they reach the required age. Zones two miles wide have been established round State nurseries and reforestation areas and round some county plantings in the south of the State. The cost of this work is briefly indicated.

Fisher (R. C.). **Tree Injection and Insect Attack.**—*Emp. For. J.* **18** no. 1 pp. 125–128, 6 refs. London, 1939.

The author reviews recent work on the effect on infestation by insects of introducing chemicals into the sap stream of trees [*cf. R.A.E.*, A **26** 453 ; **28** 335, 336, 338], and states that further work is necessary to determine more precisely whether there exists a distinct difference in the degree of susceptibility of trees killed by sodium arsenite or other poison to infestation by bark-beetles and other cambium-feeding insects and by true wood-borers such as the Scolytid and Platypid ambrosia beetles. It has been reported by A. V. Varadaraja Iyengar that the concentration of arsenic applied to trees by girdling methods is greatest in the bark, and this suggests that bark-eating insects may be more affected than those that feed on ambrosia fungi. Information is necessary from various types of forest and from places where the various groups of forest insects differ in their relative importance, since, for example, the control of bark-beetles in a tropical forest may be of little practical significance compared with that of the more injurious pinhole borers, whereas the reverse may be the case in the coniferous forests of the temperate regions, or control of both may be essential. The work already carried out shows how closely modifications in silvicultural practice affect insect populations and, in consequence, determine the extent of the damage that can be caused by forest insects.

Tyler (L. J.), Parker (K. G.) & Pechuman (L. L.). **The Relation of *Saperda tridentata* to Infection of American Elm by *Ceratostomella ulmi*.**—*Phytopathology* **29** no. 6 pp. 547–549, 2 refs. Lancaster, Pa., 1939.

A brief account is given of investigations near New York City in 1936–38 on the relationship of the Lamiid, *Eutetrapha* (*Saperda*) *tridentata*, Ol., to the spread of *Ophiostoma* (*Ceratostomella*) *ulmi*, the fungus causing Dutch elm disease. The experiments were carried out on budded American elms (*Ulmus americana*) 2–4 years old. When a suspension of spores of the fungus was atomised into wounds made

by the feeding of the adult beetles in 1936, 1937 and 1938, subsequent examination showed that 1 of 4, 1 of 8 and 4 of 10 trees had become infected, and the fungus was recovered from discoloured wood. When surface-disinfested beetles were immersed for 3 minutes in a water suspension of coremiospores and then caged for 5–12 days on the trees, 6 of 10 elms became infected.

ELLIS (D. E.). *Ceratostomella ips* **associated with** *Ips lecontei* **in Arizona.**—*Phytopathology* **29** no. 6 pp. 556–557, 1 ref. Lancaster, Pa., 1939.

Observations in Arizona in the autumn of 1938 showed that a blue-stain fungus that was identified as *Ceratostomella ips* was commonly associated with *Ips lecontei*, Swaine, in *Pinus ponderosa*. The sapwood of dead or dying trees was invariably stained, and in trees still apparently healthy but recently attacked by the bark-beetles, the stain was found to originate at their galleries. In many cases, an abnormal amount of resin had infiltrated into the sapwood adjacent to the galleries, and this condition seemed to precede the appearance of the stain. Of 54 beetles taken from standing trees and for the most part from fresh galleries that showed no evidence of stain, 45 were found by culture experiments to be infected with the fungus. Stained and unstained wood from the edges of fresh galleries consistently yielded the fungus in culture.

REEVES (E. L.), YOTHERS (M. A.) & MURRAY (C. W.). **Unusual Development of Apple perennial Canker, following Application of toxic Wound Dressings.**—*Phytopathology* **29** no. 8 pp. 739–743, 1 fig., 7 refs. Lancaster, Pa., 1939.

Serious injury to apple trees and fruit is caused in certain districts of the north-western United States by the fungus, *Gloeosporium perennans*, which is closely associated with the woolly apple aphis, *Eriosoma lanigerum*, Hsm. Of the methods adopted for control [*R.A.E.*, A **17** 667; **21** 318; **23** 275], one consists in painting the canker lesions with special dressings designed chiefly to prevent the infestation of the callus by the Aphid.

In experiments carried out in Washington in July 1932, six different wound dressings, all of which contained beeswax and a vegetable oil, were applied with a small paint-brush. No injury to the plant tissues resulted from preparations that contained ground-nut oil in combination with beta naphthylamine, nicotine sulphate or anabasine sulphate. Moreover, no injury was caused in other tests in which these three ingredients were used in various combinations with tung, perilla and soy-bean oils.

On the other hand, serious injury to the growing callus round the cankers was observed 2–3 weeks after the application of the other three dressings, in each of which a copper fatty-acid arsenite (stearo with tung oil, palmito with perilla oil and lauro with soy-bean oil) had been incorporated to test its possible fungicidal qualities. Analysis of the newly injured tissues showed that on an average they contained 256 parts As_2O_3 per million (on dry basis), whereas only a trace was present in the apparently normal uninjured bark. The necrosis produced was characteristic of perennial canker extension as it normally occurs in bark tissue in the spring after frosts, and *G. perennans* was

subsequently isolated from the newly discoloured bark round the cankers. The advance of the fungus in the injured tissue during the hottest season in the year, when under ordinary circumstances it is most inactive, was remarkable.

HUBER (G. A.). **Transmission of Black-raspberry Mosaic by the Cane-feeding Aphid,** *Amphorophora rubicumberlandi*.—*Phytopathology* **29** no. 9 p. 825. Lancaster, Pa., 1939.

Amphorophora rubicumberlandi, Knowlton & Allen [*R.A.E.*, A **25** 722] has recently been observed on wild black raspberry (*Rubus leucodermis*) and a cultivated variety (Cumberland) of it in western Washington. In the greenhouse, the Aphid transmitted the virus of black-raspberry mosaic from the wild plants to 30 per cent. of those of the cultivated variety, and from infested plants of the variety to 50 per cent. of healthy ones. In the field, the Aphid feeds only on large, rapidly-growing canes, and not on the leaves. It is seldom found less than 10–12 ins. from the growing tip. A list is given of the varieties on which it has been observed.

HUBER (G. A.), BAUR (K. E.) & BREAKEY (E. P.). **The Effect of Calcium Cyanamid on Development of Apothecia of** *Sclerotinia fructicola* **and on Population of** *Taeniothrips inconsequens* **in Prune Orchards.**—*Phytopathology* **29** no. 9 p. 825. Lancaster, Pa., 1939.

Investigations in the spring of 1939 in prune orchards in Washington State showed that applications of commercial pulverised and oiled calcium cyanamide to the surface of the soil and vegetative cover at the rate of 300 lb. per acre in March not only prevented the development of apothecia of the fungus, *Sclerotinia fructicola*, but also reduced the average numbers of adults of *Taeniothrips inconsequens*, Uzel, emerging from the soil in three orchards from 708·5, 133·5 and 48·5 per 9 sq. ft. to 79, 13·5 and 5·5, respectively.

Fifty-second Annual Report (Pennsylvania Agric. Exp. Sta.) for the Year ended June 30th, 1939.—*Bull. Pa agric. Exp. Sta.* no. 382, 77 pp., 11 figs. State College, Pa, 1939.

A section (pp. 64–67) of this report contains notes by various workers on entomological investigations in Pennsylvania in 1938–39. Flea-beetles [*Epitrix*] on tobacco leaves [*cf. R.A.E.*, A **28** 66] were best controlled by dusting with a mixture of 1 part cubé (4 per cent. rotenone) and 3 parts sterilised tobacco dust (filter dust remaining after nicotine extraction), with the addition of a wetting agent (Ultrawet 1 : 800). The dust was applied at the rate of 3–5 lb. per acre to newly set plants and 10–15 lb. to plants after topping. On potatoes, the best results were given by Bordeaux mixture (4–4–50) to which was added calcium arsenate at the rate of 1·5 lb. per 50 U.S. gals. In tests of sprays and dusts against the hairy chinch bug [*Blissus hirtus*, Montd.] in fine turf, the most effective and cheapest treatment appeared to be a dust of coarsely ground tobacco stems containing 1 per cent. nicotine, broadcast at the rate of 25 lb. per 1,000 sq. ft. Derris powder gave promising results in one series.

Investigations on sprays of lead arsenate (3 lb. per 100 U.S. gals.) against the rose leaf beetle [*Nodonota puncticollis*, Say] on apple [*cf.* **26** 287] showed that the usual programme of sprays applied against the codling moth [*Cydia pomonella*, L.] reduces injury by the Eumolpid to a minimum.

EBELING (W.). **The Grape Bud Beetle, *Glyptoscelis squamulata* Crotch.**—*Bull. Dep. Agric. Calif.* **28** no. 7–9 pp. 459–465, 3 figs., 5 refs. Sacramento, Calif., 1939.

The Eumolpid, *Glyptoscelis squamulata*, Crotch, was first recorded as a pest of grape-vines in Nevada in 1922. It was observed in 1923 on vines in a small area in southern California, where it was injurious in 1925 and from which it spread during 1926, when it also attacked the young leaves and terminal buds of peach in northern California. In 1936, it was reported on vines in another district in the south of the State. It has been recorded throughout the western United States and on a large number of plants; the author observed the adults in small numbers on beans and lucerne in one district in California.

Observations by H. J. Quayle established that the eggs are deposited in masses under the bark of the vines, and that, on hatching, the larvae drop to the ground and enter the soil where they overwinter on the roots, sometimes at depths as great as 2–3 ft. Adults appear in late February or March and feed by night on the opening buds and very young shoots, but when the latter attain a length of 1–2 ins., their development is no longer retarded by the feeding; damage is consequently less severe when the buds open during warm weather, since growth is then more rapid. The adults do not feed voraciously, but as the buds open gradually over a period of several weeks, the crop may be reduced by as much as 80 per cent. They rarely fly, and shelter during the day under loose bark, dry grass, and in crevices in the stakes of vines grown on trellises.

During investigations in 1937, no effective control was given by various repellents, poisons applied in baits or sprays, a spray of pyrethrum in oil, or various types of collars or bands other than adhesive bands. Complete protection, however, was afforded by covering the spurs of short-pruned varieties with paper bags and the canes of long-pruned ones with paper sleeves from the beginning of March until the shoots were long enough to resist attack; the crop from unprotected vines was less than one-third that produced by others protected in this manner. Delay in removing the bags may cause the foliage to become distorted, but it recovers after 24 hours, and development continues normally. Good protection is also obtained by 1–3 applications of adhesive banding materials to the base of each spur or cane and along the wires on each side of vines on trellises, provided that the adhesive is renewed after dust storms. The number of applications depends on the length of the period during which the buds are opening. This measure also affords protection against the adults of two Tenebrionids determined as *Metoponium abnorme*, Lec., and *Coniontis parviceps*, Csy., which cause a limited amount of damage. Adults of *G. squamata* are attacked by the predacious Clerid, *Enoclerus quadrisignatus* var. *latecinctus*, Lec., which occasionally occurs on the vines.

Mackie (D. B.) & Carter (W. B.). **Destruction of Alfalfa Weevil *Hypera variabilis* by Fumigation and other Means.**—*Bull. Dep. Agric. Calif.* **28** no. 7–9 pp. 466–470. Sacramento, Calif., 1939.

In view of the satisfactory results given by fumigation with methyl bromide for the control of *Hypera brunneipennis*, Boh., in baled hay [*R.A.E.*, A **28** 187], the effectiveness of this measure against *H. variabilis*, Hbst., in baled lucerne and timothy grass [*Phleum pratense*] was investigated in California.

Penetration was slower in timothy than in lucerne hay, which is coarser in texture. When 26 adults were placed in the centre of a bale of each in a refrigerator car filled with timothy hay and fumigated for 10 hours at a dosage of 1·2 lb. methyl bromide per 1,000 cu. ft., all those in lucerne were dead 3 hours after treatment, whereas 5 of those in timothy hay were active as long as 5 days after it. Complete mortality in baled timothy hay in refrigerator cars was given by fumigation at dosages of 1·2 and 2·4 lb. per 1,000 cu. ft. for 24 and 6 hours, respectively. The bromine residues estimated 72 hours after treatment for 24 hours at dosages of 1·2 and 2·4 lb. per 1,000 cu. ft. were 19·8 and 34·9 parts per million, respectively, whereas in untreated hay it was 5·8.

When bales of lucerne hay were fumigated at a dosage of 2 lb. per 1,000 cu. ft. under a gas-proof tarpaulin, all the adults were dead immediately after treatment for 12 hours, and 4 hours after treatment for 6 hours, but heavy concentrations of bromide remained. When the dosage was halved, all the adults were dead 3 hours after fumigation for 6 or 12 hours.

D. B. Mackie conducted an investigation in 1924 to determine the extent to which living adults of *H. variabilis* can be transported in lucerne meal. None of the weevils in lucerne hay ground in several types of mill survived the process. In further tests during 1939, 20 adults were placed in small jars and covered with lucerne meal to a depth of about 6 ins.; 10 survived for 3 days and all were dead after 9. Of 100 adults placed on 25th August in a wire screen cage in a standard 100 lb. sack of lucerne meal, 2 survived until 5th September, but both were dead by the following day. The authors suggest that the causes of mortality may include the dehydrating effect of the meal, its abrasive action on the intersegmental membranes, and its interference with respiration by clogging the spiracles. They further suggest that weevils may also be destroyed by the abrasive action exerted during the mechanical preparation of chopped hay.

Bailey (S. F.). **The Lily Thrips.**—*Bull. Dep. Agric. Calif.* **28** no. 7–9 pp. 479–483, 2 figs., 26 refs. Sacramento, Calif., 1939.

The distribution of *Liothrips vaneeckei*, Priesn., in the world and within the United States is summarised from the literature; with isolated exceptions, its food-plants are restricted to species of *Lilium*. It was described in 1920 from individuals collected in Holland in 1915, but it was observed in Oregon in 1921 and is probably indigenous in the United States. It was recorded in California in 1924, 1934 and 1938, but control measures are not yet necessary there. All stages are briefly described, and its life-history is summarised from the literature [*R.A.E.*, A **20** 688; **24** 108; **25** 239]. It has been stated that infested, but apparently healthy, bulbs can sometimes be distinguished by the distinctive odour emitted by the thrips.

Smith (R. H.). **Citrus Red Mite on ornamental Plants.**—*Bull. Dep. Agric. Calif.* **28** no. 7–9 p. 506. Sacramento, Calif., 1939.

During recent studies in California, *Paratetranychus citri*, McG., which had been recorded only on *Citrus*, trifoliate orange [*Poncirus trifoliata*] and rose, was observed on a number of ornamental trees and shrubs, including *Choisya ternata*, *Prunus laurocerasus*, *Cocculus laurifolius*, *Genista hispanica*, species of *Erythrina*, *Sterculia*, *Cotoneaster*, *Ficus* and *Pittosporum* and flowering peach. Infestation was severe only on the first five, *Choisya ternata* and *Prunus laurocerasus* being the preferred food-plants. The upper surfaces of infested leaves of *Choisya* become marked with conspicuous white flecks, and those of *P. laurocerasus* and *Pittosporum* with grey flecks. If the infestation is prolonged, the leaves of *Prunus laurocerasus* become reddish in colour and eventually fall. The mites infesting *Pittosporum*, peach and *Cotoneaster* are darker in colour than normal, and sometimes present a trace of purple.

Essig (E. O.). **The Blue Oat or Pea Mite, *Penthaleus major* (Dugès), in California.**—*Bull. Dep. Agric. Calif.* **28** no. 7–9 pp. 507–508, 5 figs., 1 ref. Sacramento, Calif., 1939.

In March 1922, a mite of the genus *Penthaleus* was observed attacking *Hypogastrura* (*Achorutes*) *armata*, Nic., which was swarming on the surface of fresh water in a drainage ditch in California, and an apparently similar mite was observed injuring peas. Specimens were forwarded to H. Womersley in Australia, who identified the mite as *P. major*, Dug., which is a pest of some importance in France and Australia [*cf. R.A.E.*, A **20** 508 ; **26** 582, etc.] and also occurs in South Africa and New Zealand. Its synonymy is quoted from a paper by him [**23** 499]. In California, the damage to peas was considerable, although restricted and persisting only for a short time ; infestation recurred in the following year, but has not been observed recently.

Dicke (F. F.). **Seasonal Abundance of the Corn Earworm.**—*J. agric. Res.* **59** no. 4 pp. 237–257, 7 graphs, 1 diagr., 15 refs. Washington, D.C., 1939.

A detailed account is given of observations near Charlottesville, central Virginia, and in the area adjacent to the District of Columbia (Arlington and Fairfax counties in Virginia and Montgomery county in Maryland) on the seasonal abundance of *Heliothis armigera*, Hb., on maize and the climatic factors that affect it.

Investigations at Charlottesville in 1932, in which egg counts were made at random every two days on silks attractive for oviposition (2–5 days after emergence from the ear-shoot) in plots of sweet maize planted among field maize at regular intervals of time and at suitable distances from each other, showed that the average number of eggs deposited per silk and the average percentage of ears infested by the larvae were at a minimum when general observations indicated that the maximum amount of field maize was attractive for oviposition and the larvae were numerous. These figures therefore did not give a true record of seasonal abundance. Similarly, counts made at

Arlington in 1934 and 1935 in contiguous plots of sweet maize planted at intervals of about 15 days did not give a true record, as, owing to the early beginning and prolonged period of silking, heavier populations were built up on them than on surrounding field maize. It was thus evident that a record of the seasonal abundance of maize attractive for oviposition was an essential factor, and in 1936, indices of egg-abundance were calculated by multiplying the average numbers of eggs per silk by the percentage of the area under maize that was attractive for oviposition. These indices showed that the abundance of eggs was high during the period in August when the counts showed the fewest eggs per silk and that the egg population was near its height when the available acreage of maize suitable for oviposition was at its maximum.

In surveys of field maize in Montgomery and Fairfax counties in 1934–37, the percentage of ears infested receded slightly with the rapid increase in the acreage of maize attractive for oviposition, although the population was actually increasing rapidly; the larvae were most abundant about the time when the acreage of maize in fresh silk was at its maximum. The best method of determining seasonal abundance was again to adjust the egg population per silk according to the amount of silking maize in the stage attractive for oviposition. Cannibalism causes a heavy larval mortality in late-maturing maize [*cf. R.A.E.*, A **24** 304], on which oviposition is concentrated, and reduces the accuracy of determinations of egg populations as an index of the number of larvae that enter the soil for pupation.

In northern Virginia, *H. armigera* hibernates more or less successfully in the pupal stage [*cf.* **18** 583] and probably has two complete generations annually and, in normal years, a considerable part of a third. Most of the pupae that are to overwinter become established in the soil between mid-August and mid-September, and larvae developing from eggs laid after the first week of September are of little importance in providing hibernating populations. It was found that there was a much greater winter mortality among individuals entering the soil at the end of September than among those doing so early in the month. There was a positive correlation between the average mean temperature for December, January and February, the rate of survival of overwintering pupae, and the abundance of larvae in field maize in the following season. High soil moisture and low temperature with inadequate snow cover are detrimental to the hibernating pupae. In an open insectary, a high percentage of pupae survived exposure to 14°F. on dry soil, but a heavy mortality followed this exposure when the soil was moist. In the area studied, when winter temperatures and precipitation are normal, there is sufficient survival to result in material damage to maize in the subsequent season. When the mean winter temperature falls to 30°F. or below, a reduction may be expected in the abundance of *H. armigera* in the field.

In a study of the seasonal damage caused by the larvae, Phillips & Barber found that the percentage loss by weight was lightest in maize planted before 16th May. The maize planted in the first half of May accounted for about two-thirds of the total acreage and about half the total loss in yield. This analysis showed that the loss in yield in the small acreage of late-planted maize is of minor importance. The late-planted fields are of major importance in providing overwintering pupae. The recommendation that maize should be planted as early

as is compatible with obtaining a satisfactory stand has further justification because the greater the acreage planted at such a time the lower is likely to be the percentage of ears infested.

BOBB (M. L.). **Parasites of the Oriental Fruit Moth in Virginia.**—*J. econ. Ent.* **32** no. 5 pp. 605–607. Menasha, Wis., 1939.

A survey of the larval parasites of *Cydia* (*Grapholitha*) *molesta*, Busck, was made in Virginia in 1937 and 1938. Infested peach twigs were collected in 21 orchards in six counties, and the percentage parasitism, which totalled 47·44, was calculated from the number of *C. molesta* and parasites reared to maturity. The parasites were of 10 species, of which only 2, *Macrocentrus ancylivorus*, Rohw., which had been liberated in 18 localities since 1931, and *Glypta rufiscutellaris*, Cress., were sufficiently numerous to be of value in controlling *C. molesta*. *M. ancylivorus* was by far the most abundant species; it comprised 78·44 per cent. of all the parasites reared and parasitised 37·21 per cent. of the larvae, though in different counties in which it had been liberated as early as 1931, the percentages parasitised by it varied from less than 1 to over 60. In one county in which small numbers were liberated in June 1936, parasitism was 3·45 per cent. in 1937 and had risen to 84·67 per cent. in 1938. A high degree of parasitism during the first two broods is necessary to reduce infestation by the third brood. The parasitism by *Macrocentrus* of individual broods in one county in 1935–38 is shown in a table. In 1938, 94·60 per cent. of the second brood were parasitised. *G. rufiscutellaris* was second in abundance, but it was irregular. It parasitised 8·7 per cent. of the larvae collected and represented 18·34 per cent. of the parasites reared. *M. delicatus*, Cress., comprised only 1·77 per cent. of the parasites reared in 1937 and 1938, and parasitised only 0·85 per cent. of the larvae collected. The other seven species gave a combined parasitism of only 0·69 per cent. They included a single individual of *Ascogaster quadridentata*, Wesm., which is the species previously known in the United States as *Ascogaster carpocapsae*, Vier., and is a common parasite of the codling moth [*Cydia pomonella*, L.] in Virginia [*cf. R.A.E.*, A **22** 291; **23** 553]. No liberated species other than *M. ancylivorus* was reared. In each species of parasite reared in 1938, the females greatly outnumbered the males. For all species combined, the proportion of males to females was 1 : 3.

TRAVIS (B. V.) & DECKER (G. C.). **Insecticides for June Beetle Control.**—*J. econ. Ent.* **32** no. 5 pp. 607–611, 2 graphs, 6 refs. Menasha, Wis., 1939.

In laboratory tests of insecticides against *Lachnosterna* (*Phyllophaga*) *implicita*, Horn, carried out in Iowa in 1933 [*cf. R.A.E.*, A **23** 5; **24** 690], adults from American elm [*Ulmus americana*] and willow [*Salix*] were caged with dusted leaves of the trees from which they had been taken. The leaves were sprayed with a mist of water and then given applications of dust equivalent to 1–1½, 3 or 4½ lb. per tree. Lead arsenate dust at these rates killed 74, 81 and 88 per cent. of females that received the poisoned foliage on one night and 90, 95 and 98 per cent. of those that received it on two successive nights. Similar applications of calcium arsenate dust killed 18, 36 and 51, and 52, 70 and 84 per cent., respectively. Tests were also carried out with males, but mortality among controls was very high. Magnesium

arsenate and sodium fluosilicate were not effective, and 8 inert carriers and lead carbonate were apparently not toxic. Sprays containing lead or calcium arsenate and soap were not so effective as the dusts because the waxy coating of the leaves, particularly of willow, prevented even coverage. In field tests, 80·2 per cent. of beetles taken immediately they had finished feeding from foliage dusted with lead arsenate and 29·3 per cent. of those from leaves dusted with calcium arsenate died within 96 hours. In individual feeding tests, beetles fed longer on foliage dusted with lead arsenate than on that dusted with calcium arsenate, and many did not feed at all on poisoned foliage exposed to them for one night only.

GINSBURG (J. M.) & PERLGUT (L. E.). **The Role of Calcium Hydroxide in preventing Hydrogen Sulfide from decomposing Lead Arsenate.**—*J. econ. Ent.* **32** no. 5 pp. 612–615, 7 refs. Menasha, Wis., 1939.

The following is based on the authors' introduction and summary: It has recently been shown [*R.A.E.*, A **28** 87] that small quantities of hydrogen sulphide present in spray mixtures readily decompose acid lead arsenate, releasing large amounts of soluble arsenic, and that calcium hydroxide tends to prevent this reaction. While hydrogen sulphide is generally not present in clear waters, it may be found in waters taken from stagnant ponds, polluted wells and similar sources where putrefaction of proteinaceous matter takes place. It may also be introduced directly into arsenical sprays by the use of sulphur fungicides, or small quantities of it may remain embedded in the caked residue from lime-sulphur sprays in uncleaned spray tanks. It may be formed on foliage by the action of certain organic reducing substances, such as glutathione in leaf tissue and in fungous spores, on sulphur deposited in fungicides. To what extent this gaseous compound can be held responsible for the appearance year after year of arsenical injury on apple trees in certain localities or in individual orchards within a locality, cannot be definitely stated, but it appears certain that its presence may be a contributing factor in the formation of water-soluble arsenic from lead arsenate.

A study was therefore made of the decomposition of acid lead arsenate by hydrogen sulphide in spray mixtures, and means of preventing this reaction. Lead arsenate was mixed with water containing various concentrations of hydrogen sulphide with and without different quantities of calcium hydroxide. The filtrates of these mixtures were analysed for soluble arsenic. Chemical analyses were also made of the sulphur compounds formed from the reaction of hydrogen sulphide and calcium hydroxide. The results suggest that small quantities of hydrogen sulphide decompose acid lead arsenate, forming large amounts of soluble arsenic, that calcium hydroxide readily reacts with hydrogen sulphide, changing it into calcium sulphide, and that an excess of calcium hydroxide is required to prevent the decomposition of lead arsenate by hydrogen sulphide.

BULGER (J. W.) & NELSON (O. A.). **Effects of Heat Treatments of some Calcium Arsenates on their Toxicity to Silkworms and Bean Plants.**—*J. econ. Ent.* **32** no. 5 pp. 615–619, 1 fig., 7 refs. Menasha, Wis., 1939.

The following is based on the authors' summary: In 1935, samples of mono-, di-, tri- and tetra-basic hydrous calcium

arsenates were ignited to produce the corresponding anhydrous preparations, and in 1936, 8 portions of a sample of commercial tetracalcium arsenate were autoclaved or treated with dry heat. All the hydrous calcium arsenates of the 1935 series were fairly toxic to silkworms (*Bombyx mori*, L.) fed on them by a modification of Bulger's sandwich method [*R.A.E.*, A **20** 417] or the inlay-sandwich method [**26** 134]. Monocalcium and dicalcium arsenates were the most toxic and about equally so, although the amount of soluble arsenic present varied greatly. Tricalcium and tetracalcium arsenates were only about half as toxic. The anhydrous form of each compound tested was non-toxic to the extent that when large doses were given (12–50 times the M.L.D. for hydrous forms) no median lethal dosage range was established. In general, ignition decreased the percentage of soluble arsenic present, but there did not appear to be any appreciable correlation between the percentage of soluble arsenic as determined by the A.O.A.C. method [*cf.* **25** 693] and the toxicity to silkworms or bean foliage. Heat treatments sufficiently severe to make the calcium arsenate relatively safe to bean foliage [*cf.* **23** 331] likewise made it non-toxic to silkworms. Autoclaving at 100°C. [212°F.] for 1 hour did not destroy the toxicity of the commercial tetracalcium arsenate, whereas the same treatment for 3 hours made it relatively non-toxic. This suggests that the toxicity balance of such a calcium arsenate is rather delicate, and indicates that great care should be exercised in its preparation if its toxicity is to be maintained. Dry heating at controlled temperatures does not affect the toxicity of tricalcium arsenate so readily as that of tetracalcium arsenate.

DOWDEN (P. B.). **Present Status of the European Spruce Sawfly, *Diprion polytomum* (Htg.), in the United States.**—*J. econ. Ent.* **32** no. 5 pp. 619–624, 3 maps., 9 refs. Menasha, Wis., 1939.

An account is given of the organisation and results of an intensive survey carried out during 1937 and 1938 to determine the range of *Gilpinia* (*Diprion*) *polytoma*, Htg., in the United States and the severity of infestation of spruce; liberations of parasites against the sawfly are also reported. Most of the work in 1937 was done in Maine; surveys were carried out in New Hampshire, Vermont and New York in 1938. *G. polytoma* was present, at least in small numbers, wherever inspections were made. It was estimated that 15,000 acres showed noticeable defoliation in Maine in 1937, and reports from the State entomologist indicate a marked increase in the intensity of the infestation in the northern part of the State in 1938. A very heavy infestation in southern New Hampshire involving more than 4,000 acres of saleable red spruce [*Picea rubra*] and a small area about 10 miles to the east similarly affected were discovered in September 1937. These infestations remain very severe and have spread outwards for a short distance. Most of the trees have been stripped of all their old foliage and 25–75 per cent. of their new foliage, but the trees that were most severely infested in 1937 were in a somewhat better condition in 1938. The only other point in New Hampshire in which infestation was medium to heavy was in the extreme north. Two heavy infestations were found in Vermont in 1937, one in the centre and one near the southern border. The survey of 1938 showed one of these infestations to be less severe than it had been in 1937, and the other more severe. The sawfly had spread in a northerly and

easterly direction, but again, the trees most heavily infested in 1937 appeared less so in 1938. In New York, the sawfly is quite numerous in some older, natural stands in the Adirondacks, but no defoliation has been observed there. On the other hand, a few plantations of young Norway spruce [*P. abies*], 10–30 years old, are suffering medium to heavy infestations and showing noticeable defoliation both in the Adirondack region and in the south-eastern part of the State. Up to the present, the number of trees actually killed in the United States remains small. Nevertheless, trees over a large area have been so severely defoliated that it seems questionable whether they can survive.

In Canada and the United States, up to 50 per cent. of the hibernating cocoons may be destroyed by small predacious mammals, but there are practically no indigenous parasites. In Canada, about 300 million individuals of the introduced Eulophid, *Microplectron fuscipenne*, Zett. [*cf. R.A.E.*, A **26** 77, etc.], have been bred and released, and this parasite has become generally established over most of the colonised area. Before 1938, 1,800,000 individuals had been imported into the United States from Canada and liberated throughout the areas of heavy infestation in New York and New England. During 1938, large-scale rearing of this parasite was carried out in Maine and 37 million were liberated, while about 5 million were reared at the New Haven Laboratory and most of these were released in New York, New Hampshire, Vermont and Maine. In addition to *M. fuscipenne*, small lots of several other species of parasites were received from Canada and liberated. One of these, *Exenterus marginatorius*, F., has proved its ability to maintain itself in Canada [**25** 13] *M. fuscipenne* is already established at several points in the United States.

PARR (T. J.). *Matsucoccus* **sp., a Scale Insect injurious to certain Pines in the Northeast (Hemiptera-Homoptera).**—*J. econ. Ent.* **32** no. 5 pp. 624–630, 7 figs., 3 refs. Menasha, Wis., 1939.

The species of *Matsucoccus* dealt with in this paper occurs in the north-eastern United States and feeds principally upon pitch pine (*Pinus rigida*), although short-leaf pine (*P. echinata*), table mountain pine (*P. pungens*), scrub pine (*P. virginiana*) and ponderosa pine (*P. ponderosa*) are also attacked. White, jack, Scots, Austrian, mugho and red pine [*P. strobus, P. banksiana, P. sylvestris, P. nigra* var. *austriaca, P. mugo* and *P. resinosa*] are immune. The Coccid may be found on pitch pine over most of its range in the north-eastern States, but infestations are localised. Where a single tree had been infested, trees to leeward subsequently became more infested than those to windward. Pitch pines in uninfested areas were heavily attacked after artificial infestation. Attacks were particularly heavy in Pennsylvania and the outer half of Cape Cod in Massachusetts, and heavy in other parts of Massachusetts and in Connecticut, Rhode Island and New Jersey; infestations have been found in New York, including Long Island, and New Hampshire. Feeding is confined to the current year's growth, except occasionally on *P. ponderosa*.

The eggs hatch when the new growth is 1–3 ins. long. In 1938, the first eggs hatched on 25th April in northern Connecticut and 30th April in southern Pennsylvania. The crawlers migrate to the new growth and begin to feed, losing their motility immediately. Young crawlers removed 24 hours after feeding had begun were unable

to insert their stylets again and died without moving. Development is described in detail. There are two larval instars, which last 6–9 and about 4 weeks, respectively, and are passed in a cavity, formed by the slight disintegration of the plant tissue around the base of the stylets, into which the swollen insect venter sinks. Swelling begins 1–2 weeks after hatching and continues until the first or second week of July. After the second moult, the adults force their way out of the twig, and the females migrate to a large branch or the trunk of the tree and deposit masses of 150–500 eggs under the bark scales. The average number of eggs per female, based on a count of 15 egg masses, was 293·46±15·06. The winter is usually passed in the egg stage after partial development of the embryo. During the winter of 1936–37, many of the females did not emerge from the holes in the twigs and the eggs remained in their bodies, but crawlers were able to emerge in the spring. Cold weather causes little mortality of eggs, nearly all the eggs examined surviving a temperature of −12°F. in 1937–38.

The effect of infestation on plant tissue and the formation of the galls are described. In heavy infestations, the dead areas coalesce and the twig dies, killing the insect also. In lighter infestations, the insects are able to emerge even though the twig dies later. On pitch pine, 1·2 Coccids per sq. mm. of twig surface killed the twig by the middle or end of July and 0·5 by late August or September. In experiments on the cause of injury to the tissue, extracts of the salivary glands of the Coccid, injected into the plant tissue, caused yellowing and slight swelling, while controls were uninjured. The feeding of older nymphs appeared to have more effect than that of younger ones. Where a population has built up over a period of years, considerable damage to the trees or complete mortality may result. On a sample plot of 19-year-old trees in Pennsylvania, 43 per cent. lost their leaders in 1938, and there was evidence that the insect had been killing leaders for at least 8 years. On another heavily infested plot, 74·2 per cent. of the trees lost leaders in 1938 and growth has practically ceased. Trees of all ages are attacked, but destruction is greatest to trees 10–30 ft. high. No natural enemies of the adults are known, but a thrips, a bug and larvae of a Clerid have been found feeding on the eggs.

Whitten (R. R.) & Baker (W. C.). **Tests with various Elm-wood Traps for Bark Beetles.**—*J. econ. Ent.* **32** no. 5 pp. 630–634, 3 refs. Menasha, Wis., 1939.

Tests with elm-wood traps for *Scolytus multistriatus*, Marsh., and *Hylastes* (*Hylurgopinus*) *rufipes*, Eichh., the two principal vectors of *Ophiostoma* (*Ceratostomella*) *ulmi*, the causal organism of Dutch elm disease, were begun in 1935. In that year, 5 series of traps were prepared. They included felled trees replaced on their stumps, trees killed by the injection (in auger holes) of sodium arsenite, partly severed branches, elm logs laid or stood on the ground or suspended from elm trees, and trees girdled ½–1 in. into the xylem. The predominant species of tree in all the areas used, except one, was *Ulmus americana*. Both species of bark-beetle were most active early in the afternoon. *S. multistriatus* preferred trees exposed to sunlight and *H. rufipes* preferred those in the shade [*cf. R.A.E.*, A **24** 524; **27** 190]. Felled trees were the most attractive. Girdled trees did not die, and were, therefore, not attractive. A list in order of abundance

is given of 9 species of Coleoptera, which, in addition to *S. multistriatus* and *H. rufipes*, were reared from felled and chemically-treated trees. In 1937, it was observed that elm trees killed with certain previously untried chemicals were more attractive to bark-beetles than were felled trees. The studies of 1938 included comparative tests with felled trees placed on stumps, trees girdled at breast height 1 in. into the xylem, and trees treated with sodium chlorate (5 gm. in 30 cc. solution at 30 or 60 cc. per in. diameter), ferrous sulphate (30 gm. in 75 cc. solution per in. diameter), copper sulphate (1 gm. in 30 cc. solution per in. diameter) and dry copper sulphate at 120 gm. per in. diameter. The solutions were applied under a water-tight collar round a chisel girdle [**28** 336, 337]. Trees treated with sodium chlorate were more attractive than any others to *S. multistriatus* and more attractive than any except the felled trees to *H. rufipes*. In further experiments carried out later in the season in two large field plots, elms treated with a water solution of sodium chlorate at 10 gm. of the dry salt per in. diameter were significantly more attractive to *S. multistriatus* than felled elms. No galleries of *H. rufipes* were found.

FARRAR (M. D.). **Control of Borers in newly set Shade Trees.**—*J. econ. Ent.* **32** no. 5 pp. 634–638. Menasha, Wis., 1939.

Infestation by borers of shade trees in new plantings in Illinois was studied in 1935–38. The trees concerned, in order of abundance, were elm, oak, maple, ash, hackberry [*Celtis*], lime [*Tilia*] and sycamore [*Platanus occidentalis*]. *Neoclytus acuminatus*, F., attacked 1·2 per cent. of the trees of all species and was not affected by wrapping the trunks, and a few hackberry trees were killed by *Agrilus fallax*, Say. Nearly all the losses were caused by *Chrysobothris femorata*, Ol. The order of survival for wrapped trees for the first year was hackberry, elm, ash, oak, sycamore, lime and maple. Ash and hackberry were seldom attacked by *C. femorata*. Elm was heavily attacked, but vigorous growth overcame injury as great as 50 per cent. of the trunk bark area. Oak was moderately infested and frequently killed by a few borers girdling the base of the tree. Wrapping the trunks for the first two growing seasons was the most practical method of control, and wrapping paper the most satisfactory and least costly material. The others tested were burlap, newspaper, muslin and spiral paper. Of trees that had been wrapped in their first season, 9·3 per cent. of those that were wrapped in the second season also and 60·7 per cent. of those that were left unwrapped in the second season were injured. Trees in their third and subsequent seasons were seldom injured. About 20 per cent. of the trees were attacked in the crotches and trunk above the wrappings. Most of this injury could be avoided by extending the wrappings upwards into the shaded portions of the trunk. Most of the damage began in June and July. Protecting the trunks from May to September, inclusive, was adequate.

HEADLEE (T. J.) & JOBBINS (D. M.). **Some Effects of Acid Arsenate of Lead used against the Termite,** *Reticulitermes flavipes* **(Kollar).**—*J. econ. Ent.* **32** no. 5 pp. 638–640, 2 figs. Menasha, Wis., 1939.

Acid lead arsenate was tested for the control of *Reticulitermes flavipes*, Kollar, in pine woods in New Jersey in 1937. In June, six trenches were dug 8 ins. deep, 16 ins. wide and 4 ft. long, lead

arsenate was sifted over the bottom and sides, and earth was replaced to a depth of ½–1 in. and worked with a trowel. The process was repeated until the trench was filled in. Two air-dried white pine boards 30 × 4½ × ¾ in. were buried horizontally 2 ins. below the surface of the soil in each trench. Worker termites were active in all controls by 27th August and increased throughout October. By 27th October, they had worked right through one and were cutting galleries from end to end. No sign of attack had appeared in the boards in the trenches after 5 months, though unprotected boards in contact with the ground in the same places were attacked in a few weeks. One of the boards in each trench was left in position until June 1938, by which time none had been attacked. The lowest dosage given was 0·8 oz. per cu. ft. The cost of treating soil on the site of a structure to be erected would be comparatively small.

Lund (H. O.) & Bushnell (R. J.). **The Relation of Nutritional Levels to the Growth of Populations of *Tribolium confusum* Duv. II. Egg Production in Patent Flour and in Patent Flour supplemented with Yeast.**—*J. econ. Ent.* **32** no. 5 pp. 640–642, 1 graph, 2 refs. Menasha, Wis., 1939.

Records of the egg-production of adults of *Tribolium confusum*, Duv., fed on maize-meal patent flour alone and supplemented with yeast were made to determine whether the abundance of young larvae in yeast-supplemented maize-meal in a previous experiment [*R.A.E.*, A **27** 80] was due to increased productivity of the females that had received yeast. Beetles that had been reared on maize-meal patent flour were placed in pairs, on the day after emergence, in tins with 10 oz. flour or 8 oz. flour and 2 oz. yeast. The eggs were sifted out every 3 days. The average numbers of eggs per female for beetles fed on flour alone and those fed on flour and yeast were 490·0±37·7 and 742·1±47·4, respectively, the minima 148 and 255 and the maxima 828 and 1,547, the last figure being the highest recorded for *Tribolium*. The yeast diet appeared to stimulate the early deposition of eggs.

Back (E. A.). **A new Pest of Books, *Neogastrallus librinocens* Fisher.**—*J. econ. Ent.* **32** no. 5 pp. 642–645, 1 fig., 2 refs. Menasha, Wis., 1939.

Brief descriptions are given of the larva and adult of *Neogastrallus librinocens*, Fisher [*R.A.E.*, A **26** 329], an Anobiid that was reported to be badly damaging books in the library of St. Leo Abbey, Florida, in 1937. In November 1937 and June 1938, all stages were present in books examined. The most seriously injured books had been received from St. Augustine, Florida, nearly 40 years before, and an inspection of the books in the rectory of the cathedral and the library of St. Joseph's Academy at St. Augustine showed some to be badly infested. The early cathedral records had been so damaged by Anobiids that they had been reconditioned in 1937. Examination of other libraries in Florida failed to show the presence of *N. librinocens*. As all the records of the cathedral had been sent to Havana, Cuba, for safe keeping in 1764 and returned to St. Augustine between 1890 and 1900, the author visited Havana in June 1938 and found books infested with *N. librinocens* in all the book stalls inspected and in two libraries. Some of the unused volumes and old records at Columbus Cathedral were so badly infested by *N. librinocens* and *Catorama bibliothecarum*,

Poey, that the pages could not be turned because of fluid emitted by the larvae in constructing pupal chambers. Both new and old books are attacked by *N. librinocens*. Injury is usually greatest to the binding, and cloth, threads and string used in holding pages together are cut by the larvae. The pages may also be riddled with galleries. Numerous cocoons of *Heterospilus anobiidivorus*, Mues. [**27** 461] were found in the burrows of *N. librinocens* in both Florida and Havana, and the parasite is thought to be an important agent of control. The libraries at St. Leo and St. Augustine were fumigated in June 1938 with hydrocyanic acid gas, an equivalent of 1 lb. sodium cyanide being used per 1,000 cu. ft. space, and no living insects were found in books examined about a year later.

Travis (B. V.). **Tests of Soil Treatments for the Control of the Fire Ant,** *Solenopsis geminata* **(F.).**—*J. econ. Ent.* **32** no. 5 pp. 645–650, 4 refs. Menasha, Wis., 1939.

The following is substantially the author's summary of the results of experiments carried out in southern Georgia on sandy soil and in northern Florida on clay soil with soil fumigants for the control of *Solenopsis geminata*, F. [*cf. R.A.E.*, B **27** 102]. Repeated applications of sodium cyanide not only failed to eliminate the ants from experimental areas, but appeared to increase the number of colonies, though there was a large reduction in the number of ants. Single applications of sodium cyanide in solution were most effective in clay soils when poured down the galleries instead of into holes punched in the mounds. The efficiency gained by covering the holes after introducing the fumigant did not justify the extra cost. Dry sodium cyanide did not destroy so many colonies as the solution, but considerably reduced the number of ants, and as the cost is much less than that of liquid treatments, it should be considered. The dry treatment was less effective in sandy than in clay soils. Calcium cyanide dust gave slightly better results than the sodium cyanide, in either liquid or dry form, but the additional cost of the chemical and the danger of handling powdered material do not justify its use over large areas. Gases of high density, such as chloropicrin, carbon bisulphide, carbon tetrachloride and sulphur dioxide, were not effective unless uneconomically large applications were made. Sulphur, derris and sodium fluoride were ineffective. The most promising results with soil treatments were obtained between March and mid-May. The evidence indicates, however, that soil treatments can only temporarily reduce the colonies.

Newell (W.) & Brown (A. C.). **Eradication of the Citrus Blackfly in Key West, Fla.**—*J. econ. Ent.* **32** no. 5 pp. 680–682, 1 ref. Menasha, Wis., 1939.

As *Aleurocanthus woglumi*, Ashby, had been known to occur on *Citrus* in the West Indies and Central America for many years [*R.A.E.*, A **21** 188] and living immature stages were often intercepted at Florida ports, its introduction into Florida was expected, and it was possible to institute eradication measures as soon as it was discovered at Key West in August 1934. The use of an oil with an unsulphonatable residue of not less than 85 (preferably 90 or over) and a viscosity of between 60 and 100 Saybolt (preferably between 60 and 70) was

recommended, but as such an oil was not readily available, the use of Diamond Paraffin Oil with an unsulphonatable residue of 76 and a viscosity of 105 was approved. An emulsion was made of 2 gals. fish oil soap, 2 gals. oil and 1 gal. water, and the oil content of the spray ranged from $\frac{3}{8}$ to 1 per cent. according to season. At first, the spray was applied to all the 23 known food-plants of *A. woglumi* in Key West, but as the insect population decreased, it was applied to the two primary food-plants, *Citrus* and mango, only. Sufficient material was used to drench all parts of the tree, and the applications were made with power sprayers at a pressure of about 400 lb. Although *Citrus* trees were sprayed every 20 days from September 1934 until June 1937, except for about 2 months during the spring of 1936, no apparent damage was caused to the trees. Operations were seriously handicapped by the indifference of the citizens and shortage of water. The last live immature stages were found on 26th February 1937. Six further applications of spray and four intensive inspections were made before 30th June, when discontinuance of all eradication activities except quarantine enforcement was ordered. Intensive inspections in the autumn of 1937 and the spring of 1938 had negative results and, on 13th April 1938, discontinuance of the enforcement of the quarantine was authorised. A further inspection with negative results was made in the autumn of 1938. The cost of the eradication is discussed. It is stated that with the co-operation of the citizens, it could have been completed in one year with considerable saving of expense.

SNAPP (O. I.). **Further Studies with Ethylene Dichloride Emulsion for the Control of the Peach Borer.**—*J. econ. Ent.* **32** no. 5 pp. 683–685, 1 ref. Menasha, Wis., 1939.

Further tests on the relative effectiveness of ethylene dichloride emulsion and paradichlorobenzene crystals for the control of *Aegeria* (*Conopia*) *exitiosa*, Say, on peach [*cf. R.A.E.*, A **27** 255] were carried out in Illinois in March and in Georgia in October 1938. The ethylene dichloride emulsion was poured round the base of the tree and on the lower part of the trunk. The soil was not previously prepared, but some soil was placed round the base of the tree after treatment. The paradichlorobenzene crystals were applied by standard methods. Conditions in Georgia were excellent for the building up of a high concentration of gas from paradichlorobenzene crystals, and very good control was obtained, but considerable injury was caused to trees as much as 7 years old. In Illinois, $\frac{1}{4}$ oz. caused cambium injury to trees 2 years old, though soil temperatures were too low for effective concentrations of gas to be built up, but the trees so injured did not appear to be permanently affected. Ethylene dichloride emulsion caused no injury to the trees in Illinois, but damage in Georgia, where the soil temperature was unusually high, to June-budded nursery stock and to several trees 5 and 7 years old, around which the soil was cracked, showed that it should not be used in hot weather and that cracks should be filled in before treatment. It gave consistently over 90 per cent. control in Illinois and 100 per cent. in most cases in Georgia. The results of these experiments show that paradichlorobenzene crystals should not be used on young peach trees in the south-eastern States, because of the danger of injury, and that the use of

ethylene dichloride emulsion is safer in that area even on older trees. The only change recommended on the basis of these results in the doses of ethylene dichloride emulsion previously suggested [*loc. cit.*] is the use of 20 per cent. emulsion in the south instead of 25 per cent. for trees 6 years or more old. There are indications that nursery stock on roots 1 or 2 years old may be safely and effectively treated, before it is dug, with $\frac{1}{8}$ U.S. pint per tree of $7\frac{1}{2}$ per cent. emulsion, and June-budded stock with $\frac{1}{8}$ U.S. pint of 5 per cent. emulsion. It is believed better, however, to treat all nursery stock after it is dug by spraying the soil packed and settled round bundles of the stock heeled in an upright position with a 2·5 or 3 per cent. emulsion, using 1 U.S. quart to 15 trees. Treatment should be made during the dormant season and when the soil is dry. A simple method for preparing ethylene dichloride emulsion has been developed. To make a 50 per cent. emulsion, 8 volumes water are added to 1 volume potash fish-oil soap containing about 30 per cent. soap, after which 9 volumes ethylene dichloride are added and the constituents emulsified cold by pumping.

SPENCER (H.). **Increases in Citrus Scale Insect Infestations from heavy Residue and from Copper Spray Mixtures.**—*J. econ. Ent.* **32** no. 5 pp. 686–688, 6 refs. Menasha, Wis., 1939.

The literature on the increase in the population of Coccids on *Citrus* that frequently occurs after spraying with certain fungicides is reviewed. In 1936–38, experiments were carried out in Florida on the relative importance of heavy non-insecticidal residues [*R.A.E.*, A **27** 257] and of copper [**26** 728] in scale increase. The experiment carried out in 1938 is discussed in detail. Two applications were made of each of the three sprays to be compared, one on 20th April and one on 8th July. The copper spray leaving a heavy residue (6 lb. copper sulphate, 6 lb. hydrated lime and 100 U.S. gals. water) and a non-copper spray leaving a heavy residue (6 lb. hydrated lime, 6 lb. aluminium sulphate and 100 U.S. gals. water) both caused highly significant increases in the population of *Lepidosaphes beckii*, Newm., and the percentage of fruit infested by it as compared with the unsprayed control. The copper spray leaving a low residue was ammoniacal copper carbonate (1 lb. cupric carbonate (50 per cent. Cu), 9 U.S. pints ammonium hydroxide C.P. and 100 U.S. gals. water); it caused an increase that was not considered statistically significant. Infestations of the Florida red scale, *Chrysomphalus ficus*, Ashm. (*aonidum*, auct.), were lighter and more variable than those of *L. beckii*, but responses were very similar. Both the sprays leaving a heavy residue produced highly significant increases in the number of infested fruits, and the low-residue spray gave an increase of doubtful significance. The Bordeaux mixture caused a highly significant increase in population and the other sprays a moderate one. Copper was present in the ammoniacal copper carbonate spray in sufficient amounts and adhered long enough to eliminate entomogenous fungi. It is therefore not the destruction of these that causes the increase in the Coccid population. It is not known whether the slight increase recorded after the use of the ammoniacal copper carbonate spray was caused by the copper, the light residue, sampling error or a combination of these factors.

Osburn (M. R.). **Control of the Purple Scale and the Florida Red Scale.**—*J. econ. Ent.* **32** no. 5 pp. 688–690, 3 refs. Menasha, Wis., 1939.

During 1938, a spray consisting of 2 per cent. lime-sulphur solution to which had been added 5 lb. wettable sulphur per 100 U.S. gals. water and a 1·6 per cent. oil spray made from an emulsion containing 83 per cent. oil of light-medium volatility and having an unsulphonated residue of 92 per cent. were compared for the control of heavy and light infestations of *Lepidosaphes beckii*, Newm., and *Chrysomphalus ficus*, Ashm. (*aonidum*, auct.) on *Citrus* in Florida. The sprays were applied on 4 plots on 8th July at 400 lb. pressure. About 8·4 U.S. gals. sulphur spray and 7·2 U.S. gals. oil spray were used per tree. The sulphur spray significantly reduced the population of *L. beckii* on one plot having a heavy infestation and the one with a light infestation, as compared with unsprayed controls. On the other plot with a heavy infestation and the one with a medium infestation, the reduction was highly significant. With the oil spray, a highly significant reduction in the population of *L. beckii* was obtained on the plots with heavy and medium infestations and a significant reduction on the remaining plot. The oil spray was consistently more effective than sulphur in reducing the infestations of this Coccid. The sulphur spray produced a non-significant increase in the population of *C. ficus* on all plots and the oil spray increases on two plots and decreases on the two others, none being significant.

Travis (B. V.). **Habits of the June Beetle, *Phyllophaga lanceolata* (Say) in Iowa.**—*J. econ. Ent.* **32** no. 5 pp. 690–693, 3 refs. Menasha, Wis., 1939.

Adults of *Lachnosterna* (*Phyllophaga*) *lanceolata*, Say, which had previously been rare in Iowa, were found in numbers in the south-west of the State in June 1934. The distribution of this Melolonthid in the United States is given, and also a list of 28 plants on which the adults were observed to feed, 4 of which have been recorded by other workers. In pastures, *Polygonum aviculare* appeared to be one of the main food-plants of the beetles. Two cases in which they caused moderate to severe damage to soy beans were observed. In one of these, in which the soy beans were planted in hills of maize, injury to the maize was negligible. Damage to pasture by the larvae was observed on the higher ground, the grass destroyed by them in scattered areas having been replaced by weeds. The adults are diurnal, and are active from daybreak until 7 p.m. unless the day is hot and sunny, when they enter the soil between 10 a.m. and noon. They were found during the day at depths of 2–6 ins. Sexual activities are described. The females cannot fly, and when a female becomes sexually receptive, males within a radius of about 20 yards fly to it. Crushed females attracted the males, particularly in sunlight, but crushed females produced no response in females nor did crushed males in either sex. Of 24 aromatic compounds, only isoamylamine attracted the males and none the females. The receptive and crushed females appeared to produce an emanation or odour that was rapidly dissipated by wind, as the activity of the males was always greatest to the leeward side. The response to isoamylamine was of the same type. The beetles were most numerous on 26th June, they were scarce by 3rd July

and none could be found alive three weeks later. Ten females dissected on 26th June contained 14–38 eggs, with an average of 27·3. Females oviposited by day and night. In a series of jars each containing 2,000 gm. soil moistened with 0–800 gm. water, most eggs were laid in jars in which 500 gm. water had been added. Each egg was laid in a cavity in a ball of soil $\frac{1}{4}$–$\frac{1}{2}$ in. in diameter. In soils of higher or lower moisture content, balls could not be formed.

Travis (B. V.). **Migration and Bionomics of White Grubs in Iowa, 1930–1935.**—*J. econ. Ent.* **32** no. 5 pp. 693–697, 4 graphs., 5 refs. Menasha, Wis., 1939.

The seasonal migrations of the larvae of *Lachnosterna* (*Phyllophaga*) and the depths at which the larvae and adults hibernate were studied in southern Iowa (Decatur County) in 1930–32 and in northern Iowa (Floyd County) in 1933–34. The brood of which the larvae pupated in 1931 and 1934 was brood A [*cf. R.A.E.*, A **20** 413]. The most prevalent species were *L.* (*P.*) *micans*, Knoch, and *L.* (*P.*) *hirticula*, Knoch, in the south and *L. hirticula* and *L.* (*P.*) *tristis*, F., in the north. The soils in the two districts are compared.

The following is largely the author's summary: The first downward movement of larvae for hibernation began immediately after the first cold weather in the autumn. Downward migration began between 15th and 30th October and was completed about the middle of November. Individual grubs collected during the first cold weather in 1930 (17th October) were able to penetrate unploughed ground to a depth of 20 ins. in 72 hours. The upward migration in spring started during April or early May and was completed by 10th–19th May. The brood A larvae ceased feeding and migrated downward to pupate during the first half of July. Pupae were found from 6th July to 19th September, and the adults from 4th to 24th September. The adults overwintered in the pupal cells and issued from the soil from the 27th March to 10th April. No signs of downward movement of adults before hibernation were observed. In the spring of 1934, some of the grubs did not migrate upwards to feed in the third year, but pupated in their hibernation cells, probably because of drought conditions. Larvae hibernated at a mean depth of 16 ins., and they pupated and adults overwintered at 16·6 ins. The depths of hibernation and pupation were somewhat greater in the north than in the south, apparently because of the greater distance in the north before the heavy clay subsoil was reached rather than because of differences of climate or species. Parasites of the genera *Tiphia* and *Elis* were found pupating at a mean depth of 10·8 ins. If mechanical control measures are to be attempted [*cf. loc. cit.*], they must be used during the period when the grubs are near the surface of the soil. The data here presented indicate that in Iowa this should not be later than the middle of October nor earlier than the middle of May. Natural mortality appears to be high [*cf.* **16** 507]. The average number of brood A found per plot examined in 1931 decreased from 19·07 in April to 4·61 in September. In the south, serious damage to crops in two years out of every three from 1919 to 1930 is reported. In the autumn of 1930, thousands of acres of maize, timothy [*Phleum pratense*] and bluegrass [*Poa*] were damaged or destroyed in Decatur and adjacent counties. The adults emerged as expected in the spring of 1932, many oviposited and the eggs hatched, but there was a severe

drought and the newly hatched grubs appeared unable to penetrate the hard ground and did not feed; no unusually large infestations occurred during the next two years.

SWEETMAN (H. L.). **Responses of the Silverfish, *Lepisma saccharina* L., to its physical Environment.**—*J. econ. Ent.* **32** no. 5 pp. 698–700, 23 refs. Menasha, Wis., 1939.

The general distribution and feeding habits of *Lepisma saccharina*, L., a common household pest in many parts of the world, are described. It is commonly considered to feed almost exclusively on starchy materials, but the author's observations and evidence in the literature [*cf. R.A.E.*, A **14** 543] indicate that cereals are preferred to starch and that foods rich in protein (animal matter) are preferred to either. Eggs hatched at temperatures varying from 22 to 32°C. [71·6 to 89·6°F.] (the highest percentage hatched at 22°C., the lowest temperature at which eggs were exposed), but required relative humidities over 50 per cent. at 22 and 27°C. [80·6°F.] and over 75 per cent. at 29 [84·2°F.] and 32°C. The average incubation period varied from 43 days at 22° to 19 days at 32°C. [*cf. loc. cit.*]. It increased by 1–5 days according to temperature when the relative humidity was below 75 per cent. Nymphs matured at 22, 27, 29 and 32°C. when the relative humidity was above 60 per cent., but fewer matured at 32° than at lower temperatures. All nymphs died at 37 and 40°C. [98·6 and 104°F.]. The greatest percentage matured when the relative humidity was over 75 per cent. Reproduction may begin when the insect is 3–4 months old, but growth continues afterwards. The first nymphal instar lasts 2–4 days and the second 7–10. After this, moulting occurs at intervals of 2–3 weeks throughout life. Some adults have been alive after 3½ years at 22°C. Most adults live about 2 years at 27°C., but some lived more than 3. A few lived more than 2 years at 29°C., while about 1½ years was the maximum at 32°. At 22, 27, 29 and 32°C., average totals of about 100, 100, 70 and 1 eggs were laid, nearly always at more than 75 per cent. relative humidity. The highest percentage of oviposition occurred at 84–100 per cent. Eggs are deposited singly or 2 or 3 together, 1–3 per day and on a number of successive days or weeks.

RAINWATER (C. F.). **Experiments using several Insecticides with and without Wetting Agents and Stickers for Boll Weevil Control.**—*J. econ. Ent.* **32** no. 5 pp. 700–703. Menasha, Wis., 1939.

The following is substantially the author's summary and conclusions: Experiments were carried out in South Carolina in 1938 in which several insecticides applied as dusts, both alone and in combination with different commercial wetting agents and adhesives, were compared with calcium arsenate dust for the control of *Anthonomus grandis*, Boh., on cotton. It was desired to find a substitute for calcium arsenate, because it is thought to injure the soil and severe infestation by Aphids often develops when it is applied repeatedly. The insecticides tested were two nicotine compounds, one containing nicotine bentonite and the other nicotine bentonite plus nicotine tannate, and two cryolite dusts, one a finely ground synthetic cryolite containing 90·8 per cent. sodium fluoaluminate, of which 88 per cent. of the particles were less than 10 microns in diameter, and the other a

coarsely ground cryolite containing 78·3 per cent. of sodium fluoaluminate of which 35 per cent. of the particles were more than 50 microns in diameter; a mixture of calcium arsenate and calcium carbonate without an adhesive or spreader was also tested. The dusting qualities of both cryolites were extremely poor. Statistical studies of the data showed that none of the wetting agents and adhesives increased the effectiveness of the calcium arsenate or the nicotine compounds. A synthetic liquid adhesive and spreader (Lethane) increased the effectiveness of the fine cryolite and made it comparable to calcium arsenate. Nicotine compounds gave very little or no control. There was no significant difference between calcium arsenate and the mixture of calcium arsenate and calcium carbonate. From these studies and from general observations made throughout the season, it appears that cryolite might be developed into a satisfactory substitute for calcium arsenate in the control of *A. grandis*, provided that its dusting qualities are good and that the percentage of sodium fluoaluminate is high.

NETTLES (W. C.). **A new Method of impregnating Green Fence Posts: A Preliminary Report.**—*J. econ. Ent.* **32** no. 5 pp. 703–704, 2 refs. Menasha, Wis., 1939.

A description is given of a method developed in January 1938 of treating non-durable green pine posts with water-soluble preservatives to make them resist attacks of insects and decay. Satisfactory impregnation with copper sulphate was secured on several hundred posts. Zinc chloride appeared to give less uniform penetration on some occasions. The top ends of the posts are immersed for 3 hours immediately after cutting in a trough of a solution composed of 2 lb. of the preservative to every U.S. gal. water. A disk, 1 in. thick, is then sawn off the basal end of each post to remove resinous material and this end placed in the solution. After 24–48 hours, when the solution is absorbed, the posts are removed, the ends reversed and the posts stood up for 2–4 weeks and preferably until thoroughly seasoned. The posts should receive $\frac{3}{4}$ lb. preservative to each cu. ft. wood.

TRAVIS (B. V.). **Poisoned-bait Tests against the Fire Ant, with special Reference to Thallium Sulfate and Thallium Acetate.**—*J. econ. Ent.* **32** no. 5 pp. 706–713, 4 graphs, 6 refs. Menasha, Wis., 1939.

The following is substantially the author's summary: A large number of insecticides, particularly thallium (thallous) sulphate and acetate, which are commonly used as poisons for other species of ants, were tested in baits both in cages and in the field in Florida in 1937–38 to determine their effectiveness against the fire ant, *Solenopsis geminata*, F. [*cf. R.A.E.*, B **27** 102]. Thallium sulphate in concentrations of 1, 1·5 and 2 per cent. was toxic in cage tests, but not in the field. Thallium acetate in concentrations of 2, 3 and 4 per cent. was very effective in both cage and field tests. The addition of sodium benzoate and tartaric acid to the baits appeared to repel the ants. No satisfactory results were obtained, either in cages or in the field, with any of the other insecticides. The habit of *S. geminata* of sucking juices out of baits and avoiding solid materials prevented a thorough

study of the effect of the insoluble insecticides. Contrary to expectations, 94 per cent. of the ants starved within 10 days when confined in cages without food.

Fahey (J. E.), Rusk (H. W.), Steiner (L. F.) & Sazama (R. F.). **Ease of Residue Removal from late and early Spray Applications of Lead Arsenate to Apples.**—*J. econ. Ent.* **32** no. 5 pp. 714–717, 2 refs. Menasha, Wis., 1939.

The following is substantially the authors' summary: Experiments were undertaken in southern Indiana during 1935, 1936 and 1937 to determine the relative ease of removal of residues on apples resulting from early and late applications of lead arsenate sprays. Spray schedules designed to permit such a comparison were applied in experimental orchards. Samples of fruit from spray plots were washed with hydrochloric acid solutions, and analyses were made for lead residues before and after washing. The residue load at harvest from a given number of lead arsenate sprays increases as the time of spray application approaches harvest time; thus, a final cover spray of lead arsenate may leave, at harvest, a residue load equal to that resulting from four sprays against the first brood [of *Cydia pomonella*, L.]. The residues from sprays applied in the second-brood period are more easily removed by washing than are residues from the same number of the same sprays applied during the first-brood period. The use of oil adhesives with organic insecticides, in second-brood sprays, makes the residue of lead arsenate from first-brood sprays as difficult to remove as are residues from lead arsenate used throughout the season.

Berry (P. A.). **Biology and Habits of *Ephialtes turionellae* (L.), a Pupal Parasite of the European Pine Shoot Moth.**—*J. econ. Ent.* **32** no. 5 pp. 717–721, 6 refs. Menasha, Wis., 1939.

Pimpla (*Ephialtes*) *turionellae*, L., which has often been recorded as *P. examinator*, F. [*R.A.E.*, A **13** 479; **19** 29], is an important parasite of the pupae of *Rhyacionia buoliana*, Schiff. (European pine shoot moth) in Europe. It was imported into the United States and released in areas infested by this Tortricid in 1933–35. Only 160 adult parasites were reared from the 699 parasitised host pupae received during the 3 years, and since these did not emerge until after the adults of *R. buoliana*, attempts were made to rear the parasite on alternate hosts and liberate it in greater numbers when pupae of *R. buoliana* were abundant in the field. Preliminary experiments in rearing were begun in 1934. Pupae of *Pieris rapae*, L., and *Plusia* (*Autographa*) *brassicae*, Riley, were first exposed to attack and were readily accepted when in webs or wrapped in absorbent cotton, and *Pyrausta nubilalis*, Hb., was very satisfactory, particularly for building up a stock of parasites in the winter. Several other Lepidoptera were tried with varying results, but *Tortrix* (*Cacoecia*) *cerasivorana*, Fitch, the pupae of which occur together in webs in masses of 100 to 1,000 in nature [*cf.* **25** 251], was the most satisfactory for use on a large scale. The pupae were exposed in lots of 100–200 after the outer webbing had been removed and the larger nests broken up so that most of the pupal cases were exposed. By this method a high percentage of parasitised

pupae was obtained. Only 40 and 25 overwintering females of *P. turionellae* were retained for rearing in 1935 and 1936, respectively, and 1,453 and 4,145 adults were obtained, the latter number in two generations. In 1937, about 250 females were available and 13,716 females were reared in two generations. A list is given of 11 species of Lepidoptera, an Ichneumonid and a Tachinid on which *P. turionellae* was reared. *Notolophus antiqua*, L. was the only one that showed a decided resistance.

The development of half- to full-grown larvae was retarded in the laboratory for 30–60 days by reducing the temperature to 32–38°F., and the larvae developed normally when exposed to higher temperatures, but no attempts were made to carry the immature stages through the winter. In an unheated insectary in Massachusetts, hosts attacked as late as October produced adults. Females overwintered successfully, and during the severe winter of 1934–35, there was a mortality of only 10 per cent. when the parasites were kept in wooden boxes in an insectary where the temperature dropped to −11°F. A few of the late-emerging males always survived the winter. Pairing occurs readily at any temperature at which the adults are active. The males may continue to pair during their entire life. The females will pair a number of times during the first day or two after emerging, but fertilised females will not pair afterwards. Females that have not been fertilised will pair when they are several months old. Females reared at temperatures of 80°F. or more begin ovipositing soon after emergence. Those developing at 50–65°F. do not oviposit until 1–2 weeks after they become adult. If reared at high temperatures and then cooled and kept at 40°F. for a week, they will not oviposit until 4–7 days after being subjected to temperatures of 70–80°F. Adults developing in October would not oviposit in the following spring until they had been subjected to temperatures of 50–75°F. for two weeks. The egg may be deposited in any part of the pupa. The egg, larval and pupal stages are passed within the host pupa and last 2–4, 6–10 and 6–10 days, respectively. At prevailing temperatures in New England, six complete generations were reared in 1935. Adults fed eagerly on loaf sugar and honey water solution and the females on the juices of the host pupa also [*cf.* **25** 767]. In captivity, many host pupae, both parasitised and unparasitised, were killed by this habit. The sex ratio appears to be affected by the size and succession of hosts, parasites reared from large hosts always producing a higher proportion of males when allowed to reproduce on a smaller host, and parasites from small hosts producing a higher proportion of females when allowed to reproduce on a larger host. The ratio of males to females ranged from 2 : 1 to 1 : 3. When successive generations were reared on the same host, the ratio averaged 4 : 5. Males were always present in a proportion of about 3 : 1 in generations reared from overwintered females that had paired before hibernation.

During the period 1935–37, 1,732 males and 10,744 paired females were liberated. Several colonies of overwintering females were released in the spring when pupae of *R. buoliana* were in the field, but most colonies were released in the summer in the hope that they would propagate on other hosts or survive until the following spring. Colonies were released in Connecticut, New York and New Jersey, two were sent to Ontario, and colonies of 3,000 and 2,000 paired females were released in infestations of *Malacosoma disstria*, Hb., in Minnesota and *Hemerocampa pseudotsugata*, McDunn., in Idaho, respectively. No recoveries have yet been made.

Barber (G. W.). **Observations on *Collabismodes cubae* Boh. as a Tomato Pest.**—*J. econ. Ent.* **32** no. 5 pp. 725–726, 1 ref. Menasha, Wis., 1939.

Early in March 1939, attention was called to an infestation of tomatos in Florida by *Collabismodes cubae*, Boh. [*cf. R.A.E.*, A **22** 601 ; **23** 277]. The infestation first observed was in one of the most south-easterly of the cultivated fields in the State, and it is suggested that the weevil had reached Florida in floating plant remnants or had been carried by wind from Cuba. Observations indicated that it might become a serious pest of tomatos if it were able to spread northwards. However, it is hoped that, as it is a tropical species, it may not be able to do so, or that it will not survive the summer floods. In the first week of March, the larvae were nearly full-grown. They occurred at the rate of 1–4 per plant and fed by burrowing in the main stem from below the surface of the soil to a point 2–3 ins. above it. The infestation was sporadic in the field. In some cases, 20 plants in a group died, but the total number of plants killed probably did not exceed 1 per cent. Pupation occurred during the last week of March. The full-fed larvae constructed cocoons of fragments of tomato stem within the burrows, and the adults gnawed through the cocoons and adjoining stem to emerge. The average number of pupae per plant in 20 plants was 1·7.

Shirck (F. H.). **Observations on the Flight of Adults of the Sugar-beet Wireworm, *Limonius californicus* (Mann.).**—*J. econ. Ent.* **32** no. 5 p. 726. Menasha, Wis., 1939.

Adults of *Pheletes* (*Limonius*) *californicus*, Mann., were collected in flight in Idaho in May 1937. The majority were females, and 35 of these were confined in cans of moist soil, in which they laid, on an average, 39 eggs each. In 1938, collections were made in a lucerne field on every day on which flight occurred between 30th April and 29th May. Maximum flight usually occurred between 2 and 4 p.m. on still days when the temperature in the shade was 70–80°F. In many instances, the beetles rose to a height of more than 30 ft. and flew further than the eye could follow. On 11 days, 47 males and 743 females were caught, and the females laid, after capture, an average of 38·8 eggs each, which is about 22 per cent. of the normal egg production of the species in the Pacific Northwest. The 21 females collected on 30th April laid an average of 85·7 eggs each or about 50 per cent. of the normal number.

Blanton (F. S.). **Aphid Transmission of the Virus causing White Streak of Narcissus.**—*J. econ. Ent.* **32** no. 5 pp. 726–727, 4 refs. Menasha, Wis., 1939.

An account is given of tests carried out in 1938 on the transmission of the virus causing white streak of narcissus by *Macrosiphum* (*Illinoia*) *solanifolii*, Ashm., and *Aphis rumicis*, L. The Aphids were placed in cages containing both healthy and diseased plants. The control cages contained no Aphids. In the tests with *M. solanifolii*, which were carried out in the greenhouse, 67 per cent. of the plants became infected, whereas all the controls remained healthy. In tests with *A. rumicis*, which were carried out in the field, an average of 81 per cent. of the plants in the cage containing the Aphids and 9 per cent. in the control cage became infected.

LANGE, jr. (W. H.). **Notes on the Sugar-beet Root Aphid in California.**—*J. econ. Ent.* **32** no. 5 pp. 727–728, 7 refs. Menasha, Wis., 1939.

During 1938, asexual viviparous forms of a species of *Pemphigus* were found in the Half Moon Bay area of California every month on or about the roots of *Rumex crispus*, without any evidence of sexual forms being produced. Alatae submitted to E. O. Essig were identified as *P. balsamiferae*, Williams, which causes galls on poplar and is commonly considered a synonym of *P. betae*, Doane, which infests the roots of beet, poplar being the winter and beet the summer food-plant [*cf. R.A.E.*, A **2** 251; **5** 17 etc.]. Poplars were not found within 10 miles of the area where populations on dock were maintained. Alatae from dock in cellophane cages emerged in late February and March and again during September and October. *Rumex conglomeratus* and *R. salicifolius* were not so vigorously attacked as *R. crispus*. There was no evidence that the spread of infestations on dock could be attributed to beet. The difference in the behaviour in different parts of the United States of the Aphid commonly called *P. betae* is thought to indicate either that there are biological variations in the same species or that several species are involved.

ELLISOR (L. O.). **A recent Pecan Pest,** *Cacoecia infumatana* **(Zell.).**—*J. econ. Ent.* **32** no. 5 p. 728. Menasha, Wis., 1939.

In the spring of 1936, several contiguous pecan trees in southern Louisiana were completely defoliated by larvae of *Tortrix* (*Cacoecia*) *infumatana*, Zell., and the same trees have been defoliated in each year since. Moreover, the infestation has spread to other trees in the immediate vicinity and as much as 25 miles distant, though very large numbers of trees situated between and among the infested ones remain free from attack. This Tortricid appears to have only one generation a year. The eggs are laid on the branches during the latter half of May and hatch when the leaf-buds are opening in the following spring (about 1st April). The larvae are gregarious and feed inside a nest composed of webbed-up leaves and small branches. Many pupate in the nests, but others crawl down the branches and trunk of the tree, spinning a continuous web, and pupate on vegetation or other objects on or near the ground.

DEBACH (P.). *Microterys titiani* **Gir., an Egg Predator of** *Lecanium corni* **Bouché.**—*J. econ. Ent.* **32** no. 5 pp. 728–729, 1 ref. Menasha, Wis., 1939.

Larvae of the Encyrtid, *Microterys titiani*, Gir., were found feeding externally on eggs beneath the scales of females of *Lecanium corni*, Bouché, taken on manzanita [*Arctostaphylos*] in California in June 1939. Only one other known species of *Microterys*, *M. sylvius*, Dalm., is ectoparasitic [*R.A.E.*, A **8** 126]. *M. titiani* was reared from egg to adult on eggs of *L. corni* in small glass cells. The egg and larval stages are briefly described. The eggs are deposited among those of *L. corni*, and the newly hatched larvae start feeding immediately. There are four larval instars and a prepupal stage in which feeding and most movement ceases and the meconium is cast. The larvae are gregarious feeders, 1–10 having been found beneath single scales. At room temperature in June and July 1939, the four larval instars and the prepupal and pupal stages lasted, respectively, 2, 1, 1, 4, 1 and 8 days. The adults emerge through an irregular hole gnawed usually near the

base of the scale. The adult female apparently does not oviposit until later in the summer or autumn, since the ovarioles remain in an immature condition for at least 2 weeks after emergence.

McCauley (W. E.). **Tandem Doses of Calcium Cyanide for controlling Insects on Plants.**—*J. econ. Ent.* **32** no. 5 pp. 729–730. Menasha, Wis., 1939.

In November 1936, an investigation was begun in Illinois to check the results being reported by commercial users of Cyanogas calcium cyanide and to develop a more efficient method of using Cyanogas for the control of certain greenhouse pests. The cumulative action of fumigation with Cyanogas G-fumigant at intervals of 7–10 days and at the rate of $\frac{1}{4}$ oz. per 1,000 cu. ft. resulted in very satisfactory control of *Pinnaspis* (*Hemichionaspis*) *aspidistrae*, Sign., *Phenacoccus gossypii*, Tns. & Ckll., *Chrysomphalus ficus*, Ashm. (*aonidum*, auct.), *Trialeurodes vaporariorum*, Westw., and *Macrosiphum* (*Macrosiphoniella*) *sanborni*, Gill., on various ornamental plants in the greenhouse and caused no apparent injury to the plants, which included chrysanthemums. The treatment failed to control *Thrips nigropilosus*, Uzel, *Pseudococcus citri*, Risso, *P. maritimus*, Ehrh., and *Tetranychus telarius*, L. Tests with heavy charges of Cyanogas G-fumigant at short exposures indicated that 2 oz. per 1,000 cu. ft. for 2 hours would give satisfactory control of *P. citri* on gardenias without injuring the plants, but the method was not successful against thrips, as the toxic concentrations scorched the food-plants (chrysanthemums). Fumigation-chamber experiments also were carried out with *T. nigropilosus*. The equipment used is described. Many dosages and exposure combinations were tried, but all that were effective against the thrips injured the chrysanthemums. A method termed "tandem" fumigation was then tested, in which the thrips were subjected to successive weaker doses of the gas. The periods of exposure were separated by intervals of ventilation, each being timed to coincide with the beginning of recovery of the thrips from the stupor that always followed exposure to the gas, whatever the concentration. The results were very encouraging. Fumigation with $\frac{1}{2}$ oz. Cyanogas G-fumigant for 1 hour failed to control the thrips and slightly scorched the tips of the chrysanthemums. However, when fumigation with $\frac{1}{2}$ oz. for 1 hour was followed by ventilation for 3 hours and then repeated, 28·4 per cent. control of the thrips was obtained and the injury to the chrysanthemums was no worse. When fumigation was repeated a third time after ventilation for 2 hours, 89·6 per cent. control resulted without increase in the injury to the plants.

Jewett (H. H.). **Control of Sod Webworms in Lawns.**—*Bull. Kentucky agric. Exp. Sta.* no. 391 pp. 89–106, 4 figs., 8 refs. Lexington, Ky, 1939.

The author reviews work that has been done in the United States on the control of sod webworms (*Crambus* spp.) and gives the results of observations in Kentucky on the flights of *C. mutabilis*, Clem., *C. trisectus*, Wlk., and *C. teterrellus*, Zinck., which are commonly found infesting sod in the bluegrass [*Poa*] region. The records indicated that *C. teterrellus*, which is the dominant species, had two generations in 1935 and 1936 and at least a partial third in 1934 and 1937, while the others had two generations in all four years.

In experiments in 1934–37 on the control of the larvae, adults were placed in field cages each enclosing 20 sq. ft. of bluegrass sod, in which they oviposited and which was kept practically as a lawn. No larvae hatched in 1936, probably because of the excessively high temperatures at the time when the moths were taken. A list is given of the insecticides that were tested, with the concentrations and rates at which they were applied to the sod. All the sprays were applied several days before pupation began, and the tests were made mainly in June 1934 and 1935 on first-generation larvae and in September 1937 on those of the second generation. As a result of preliminary tests, 4 insecticides were selected for further investigation. Two of them were pyrethrum extracts, of which the second contained 2 gm. pyrethrins per 100 cc. They were used at dilutions of 1 oz. to 4 U.S. gals. water and were applied at the rate of 1 U.S. gal. per 10 sq. ft. The first was used in 1934 and 1935 and the second in 1937. The other two were a kerosene emulsion made of ½ lb. hard soap, 1 U.S. gal. water and 2 U.S. gals. kerosene, which was used at a dilution of 1 : 10 and applied at the rate of 1 U.S. gal. diluted emulsion to 10 sq. ft. ; and a spray containing 1 lb. lead arsenate in 10 U.S. gals. water with 0·1 U.S. pint liquid tar soap, which was applied at the rate of ½ U.S. gal. to 20 sq. ft. The percentage mortalities obtained in the three years were 95·5, 90·2 and 96·1 with pyrethrum, 91·2, 91·7 and 93·2 with kerosene, and 89·4, 91·9 and 86·1 with lead arsenate. The only differences that were statistically significant were those between lead arsenate and pyrethrum in 1934 and between lead arsenate and both the other sprays in 1937. The sod was not injured by the pyrethrum or lead arsenate sprays, but the kerosene emulsion caused slight scorching in one instance. Sprays of barium carbonate, nicotine oleate and two proprietary insecticides and a poison bait [*R.A.E.*, A **25** 698] were ineffective, and dusting with lead arsenate powder or treating the sod with dichloroethyl ether [**25** 437] failed to give a satisfactory kill.

JEWETT (H. H.). **Four Wireworms found in Bluegrass Sod.**—*Bull. Kentucky agric. Exp. Sta.* no. 392 pp. 107–118, 18 figs., 5 refs. Lexington, Ky, 1939.

Some of the wireworms that live in soil under bluegrass [*Poa*] in central Kentucky attack crops that follow the turf in rotation, tobacco being one of those that are frequently severely injured. The commonest species that damage tobacco are *Drasterius mellillus*, Say (*Aeolus dorsalis*, Say), which is the most injurious, *Conoderus auritus*, Hbst., which is next in importance, *C. bellus*, Say, which causes little apparent damage, and *C. lividus*, DeG., which only occasionally attacks tobacco but is rather numerous in the turf. As the larvae of these four species are very much alike in colour, shape and size at various stages of development, detailed descriptions are given of them, based on exuviae of full-fed larvae.

FENTON (F. N.). **Biology and Control of** *Phyllophaga lanceolata*.—*Proc. Okla. Acad. Sci.* **19** pp. 87–91, 8 refs. Norman, Okla., 1939.

Adults of *Lachnosterna* (*Phyllophaga*) *lanceolata*, Say, appeared in numbers in north-central and south-western Oklahoma in the summer of 1937, and the larvae caused widespread damage to wheat in the

autumn, when many fields had to be replanted several times. The winter of 1937–38 was mild and favourable to the larvae, which continued to feed on the roots of young plants until a severe late spring frost caused them to migrate for a time below the frost line. Favourable spring conditions, however, enabled the crop to outgrow the attack.

L. lanceolata has been recorded on wheat in Oklahoma, where outbreaks occur sporadically, Kansas and Texas. Food-plants of the larvae and adults are quoted from the literature. The adults have been observed in Oklahoma on soy beans, sunflower (*Helianthus annuus*), evening primrose (*Oenothera laciniata*) and various weeds. The larvae sometimes come to the surface, cut off leaf blades and carry them to the base of the plant, where they feed on them. The greatest injury in the spring is caused by the first-year larvae ; second-year larvae taken from the soil soon pupated when subjected to warmth, and as pupation, which occurred in the field as early as 29th April, is preceded by an inactive period, they probably feed little after mid-April. The larvae are very sensitive to changes of soil temperature and migrate downwards during frost or in mid-summer when the surface soil becomes hot. Field observations in which soil samples were taken from March to September showed that the larval population decreased until the end of April and remained at a minimum until September. This was partly due to the pupation of the second-year larvae, which began at the end of April and reached its maximum on 12th May. The adults were first observed about the third week in May and were feeding freely a week later. Pairing began early in June. Females examined on 12th June contained 67–136 eggs in varying stages of maturity, but no eggs were deposited under cage conditions. The beetles began to die off about the second week in June, the males before the females, and by the end of June practically all were dead. The chief natural enemies of *L. lanceolata* are skunks, moles and the Asilid, *Promachus bastardi*, Macq., of which the adults feed on the beetles and the larvae on the grubs.

Investigations were begun in February 1937 on the susceptibility of various field crops to attack by larvae of this Melolonthid. Potted plants were grown in an unheated greenhouse, and six acres of land in a heavily infested wheat field were planted with different crops. Of the plants exposed to the larvae in pots, maize, cotton, cowpeas, darso [a variety of *Sorghum*] and oats showed no injury, though some of the plants were thinned and some kept dry to retard root development. The lack of injury to oats was unexpected, as it was reported that they were severely damaged when planted in infested land. Wheat was injured in some of the pots, but was never entirely destroyed. Rye showed most injury, the young plants being cut off under the soil. The numbers of plants developing per pot averaged 10·5 in infested pots and 52 in the controls, while in another series in which the rye was thinned, these averages were 7·5 and 16. In the field experiment, examination of the soil showed an average infestation of 18·36 larvae per square yard, 56·2 per cent. having hatched in the previous year, though their distribution was not uniform. Maize, darso and soy beans were planted in April and early May, each in three plots. In spite of the heavy infestation, good stands were secured. When the soy beans were about 6 ins. high they were destroyed in a few days by the newly emerged adults, but the maize and darso were not injured by larvae or adults.

KOBLITSKY (L.). **Determination of Arsenic in Soil treated with Acid Lead Arsenate.**—*J. Ass. off. agric. Chem.* **22** no. 3 pp. 680–683, 6 refs. Washington, D.C., 1939.

Applications of acid lead arsenate are made in the United States to destroy larvae of *Popillia japonica*, Newm., in soil in accordance with regulations [*R.A.E.*, A **28** 89, 90]. Since a dosage of 1,500 lb. acid lead arsenate per acre must be maintained to ensure their destruction, investigations were carried out to devise a method of determining the arsenical concentration in a given sample of soil. Directions are given for obtaining representative samples of soil and for applying the method of analysis that was evolved.

MILLS (H. B.). **Montana Insect Pests for 1937 and 1938. The twenty-seventh Report of the State Entomologist of Montana.**—*Bull. Mont. agric. Exp. Sta.* no. 366, 32 pp., 8 figs., 3 maps, 1 ref. Bozeman, Mont., 1939.

In 1937, injury to cultivated crops by grasshoppers was intense in many parts of Montana, the areas most severely infested being also affected by drought. Hatching started about mid-May. Of the species involved, *Melanoplus mexicanus*, Sauss., predominated throughout the eastern two-thirds of the State [*cf. R.A.E.*, A **26** 680], and *M. differentialis*, Thos., was abundant, for the first time in many years, in the northern half of this area. The total losses attributable to grasshoppers were estimated at nearly £440,000, and the value of the crops saved by control measures at over £277,000. The 1938 season was characterised by a definite break in the drought, and there was a profuse growth of cultivated and wild vegetation ; hatching of hoppers was late and protracted, and few hatched before the first week in June. There was again a great variety of species, those of importance being *Camnula pellucida*, Scudd., *M. mexicanus* and *M. packardi*, Scudd., in the western third of the State, *M. bivittatus*, Say, *M. packardi*, *C. pellucida* and *Aulocara elliotti*, Thomas, in the central third, and *M. mexicanus* in the eastern third. The prevalence of cool damp weather was, however, an important factor in reducing the grasshopper population, and some control was given locally by fungous disease and Sarcophagid parasites. A great decrease in infestation was therefore expected throughout most of Montana, but a severe invasion of *M. mexicanus* from the Dakotas occurred in early July, the grasshopper population being suddenly increased from 2–15 to 40–500 per sq. yard. Large migrations took place when the temperature was above 80°F. and a southerly wind was blowing. The aggregate loss in cultivated crops in the 17 counties definitely affected by this invasion was estimated at nearly £1,300,000 and in the whole State, including the less seriously invaded counties, at nearly £1,333,000. The campaign instituted resulted in a saving of crops valued at over £200,000.

What was probably the worst infestation by the Mormon cricket [*Anabrus simplex*, Hald.] ever experienced in the United States occurred in 1937 [*cf.* **26** 580], and 45 per cent. of the area invaded by this Tettigoniid was in Montana, where damage was caused to 976,563 cultivated acres and 6,511,132 acres of range, representing an increase of 59·9 per cent. over 1936. Owing to a successful campaign (in which 17 counties participated), the injury sustained increased by only 13·8 per cent. over that of the preceding year [*cf.* **26** 44], and

the value of the crops saved amounted to over £1,000,000. In 1938, a great decrease in the population of the insect became evident throughout almost all the State. To reduce the cost of the campaign, power dusters and barriers were used more extensively instead of hand labour. The effect of the infestation on range land is discussed.

An outbreak of *Cirphis unipuncta*, Haw., which is distributed throughout the State, occurred in the Sidney area in July 1937. The larvae were controlled by means of a poison bait distributed at about 4 p.m. and consisting of 4 lb. sodium arsenite, 100 lb. bran, 12 U.S. gals. water and 8 U.S. quarts cane molasses; the addition of the molasses was found in special tests to be of value [*cf.* **26** 540], although the results were somewhat inconclusive. Where irrigation water was available, a small stream of water running through the ditches proved an excellent barrier, and steep-sided ditches kept dusty by dragging a log through them were also effective.

The Pentatomid, *Chlorochroa sayi*, Stål, was less abundant than in previous years, but continued to injure wheat in one area. The infestation in Montana, which is in its seventh year, showed little tendency to disappear, and its continuance may possibly be the result of large acreages of abandoned cropland that provides wild food-plants on which the nymphs feed in spring. Two Capsids, *Labops hesperius*, Uhl., and an undescribed species of *Conostethus*, were abundant on range grasses in one locality, and also infested winter wheat up to the end of May, causing mottling of the leaves; in cases of intense feeding, the leaves curled and withered.

An outbreak of *Loxostege sticticalis*, L., on sugar beet occurred in 1938 and was comparable in severity to that in 1932 [*cf.* **21** 229]. In some cases, entire fields of beet were completely destroyed. Contrary to the general rule, most of the eggs were laid on the plants in the field and not on weeds at the edges, probably because the adults emerged late and a considerable amount of foliage was present in the beet fields at the time of oviposition. Owing to the abundance of the larvae, the usual insecticides proved of little value. A survey showed that the percentage of first-generation larvae that entered the prepupal stage was 45–50, instead of the usual 2–5. Observations in Europe have indicated that such a condition generally precedes a severe outbreak.

The Galerucid, *Diabrotica melanocephala*, F. (*vittata*, F.), was very abundant on cucurbits in Yellowstone County. Bacterial wilt, of which the adult is a vector, has not appeared in association with it in Montana. The best control of the adults is given by dusting the plants with a mixture (1 : 20) of calcium arsenate and burned gypsum [*cf.* **28** 178]. The plants should be kept covered with the dust from the time they appear above ground in the spring until the adults of the first generation have disappeared.

Paratrioza cockerelli, Sulc, was generally distributed in 1938 on tomatos and potatoes, the injury to the latter being increased by the purple-top [Psyllid yellows] caused by it; the plants affected produced very small tubers, which in many cases did not justify the cost of digging. Experiments showed that young nymphs are killed by sulphur dusts or by a spray of lime-sulphur (33°Bé, 1 : 40) applied with force to the lower surfaces of the leaves early in the season, before purple-top has been produced.

The Sphingid, *Protoparce sexta*, Joh., was recorded on tomato in Montana for the first time in the summer of 1938, although it probably

occurred there earlier. The best method of control in gardens is hand collection, while for large plantings a dust of lead arsenate (5 lb. per acre) is recommended in other parts of the United States [*cf.* **27** 431]. Lead arsenate should not be applied during the 10 days before the tomatos begin to ripen.

Eriosoma americanum, Riley, was abundant in both years and in some areas was a limiting factor in the planting of American elms [*Ulmus americana*]. The trees are attacked in the spring, the leaves being curled and distorted. Winged adults appear in June and migrate to the roots of Juneberry [*Amelanchier*], and the autumn migrants return to elms in September and lay the overwintering eggs [*cf.* **4** 132]. In experiments on the control of these eggs, fair results were given by a thorough application of a dormant spray of 3–4 per cent. oil emulsion. Other pests observed included the maple twig borer, *Proteoteras aesculana*, Riley, which has not previously been recorded from Montana; *Nematus* (*Pontania*) *bozemani*, Cooley, the larvae of which folded the edges of poplar leaves; and *Agrotis orthogonia*, Morr., for which the weather conditions were unfavourable in 1938.

HALL (D. G.). **Two new Species of Tachinidae parasitic upon Hemlock Sawfly Larvae in North America (Diptera : Tachinidae).**—*Proc. ent. Soc. Wash.* **41** no. 8 pp. 239–243, 8 refs. Washington, D.C., 1939.

Descriptions are given of the adults of both sexes of the Tachinids, *Tsugaea nox*, gen. et sp. n., and *Diplostichus sellersi*, sp. n., both reared in numbers as parasites of the larvae of *Neodiprion tsugae*, Middleton, on hemlock [*Tsuga*] in Oregon. The genus *Tsugaea* is within the scope of *Zenillia* in the sense of Aldrich and Curran. *D. sellersi* was also reared from *Neodiprion* sp. in California.

CUSHMAN (R. A.). **New Ichneumon-flies parasitic on the Hemlock Sawfly** (*Neodiprion tsugae* **Middleton).**—*J. Wash. Acad. Sci.* **29** no. 9 pp. 391–402, 5 refs. Menasha, Wis., 1939.

The new Ichneumonids described in this paper from *Neodiprion tsugae*, Middleton, in Oregon are *Habrocryptus* (*Ischnus*) *oregonensis*, *Spilocryptus neodiprionis*, *Microcryptus* (*Aptesis*) *tsugae* and *Lamachus oregon*, which were primary parasites, *Thysiotorus latifrons* and *Panargyrops areolaris*, which were probably secondary, and *Delomerista diprionis*, which was also reared from *N. tsugae* from Queen Charlotte Island, British Columbia, *Diprion similis*, Htg., from Connecticut and Ontario, *Gilpinia* (*D.*) *polytoma*, Htg., from New Hampshire and two unidentified species of *Neodiprion*, one on *Pinus rigida* and *P. resinosa* in Maine and the other on *P. banksiana* in Quebec.

COMPERE (H.). **Mealybugs and their Insect Enemies in South America.**—*Univ. Calif. Publ. Ent.* **7** no. 4 pp. 57–73, 1 pl., 5 figs. Berkeley, Calif., 1939.

In this further paper on mealybugs and their natural enemies in South America [*cf. R.A.E.*, A **26** 212], the author points out that as yet comparatively little is known of the mealybug fauna of Brazil, although Hambleton has recorded nearly 50 species on cultivated

plants there [*cf.* **24** 502]. In central Chile, however, the only species observed were *Pseudococcus gahani*, Green, which is the most injurious and abundant, *P. citri*, Risso, *P. adonidum*, L. (*longispinus*, Targ.) and *P. maritimus*, Ehrh. All are important there and were presumably introduced with imported nursery stock. No effective natural enemies were present. In Brazil, the majority of the mealybugs do not cause any great injury, and this is attributed to the control afforded by parasites and predators. The observations recorded were made with a view to the importation into California of the most beneficial South American species, and in this respect special attention was given to *P. maritimus*, *P. citri*, *P. adonidum*, *P. gahani* and *Phenacoccus gossypii*, Tns. & Ckll., which also occur in California.

The first part of the paper contains taxonomic notes on 9 Encyrtids. Five from Brazil are described as new, descriptions of both sexes being given for the first two and of the females only for the others. They comprise *Tetracnemus peregrinus* from *Pseudococcus adonidum* and also from material from Argentina ; *Waterstonia diversicolor*, from a species of *Pseudococcus*, possibly *P. nipae*, Mask., on bamboo ; *Leptomastix bahiensis* from *Ferrisiana virgata*, Ckll., on *Macquilla tomentosa* ; and *Ericydnus clavicornis* and *Metaphycus alboclavatus* from unidentified species of *Pseudococcus*. A key to the species of *Waterstonia* is included.

A brief description is given of *L. dactylopii*, How. A pair of adults of this species, bred in California in December 1934 from *P. citri* taken on *Cassia splendens* and chayotes [*Sechium edule*] in Brazil were allowed to pair in the laboratory, and the female was then placed in a cage containing potato sprouts infested by *P. citri*. By the end of 1935, over four million individuals of *L. dactylopii* had been bred in insectaries and released in California ; it is now established and gives promise of being of considerable value. A single female identified as *Aenasius advena*, Comp., which was described from Hawaii [**26** 212], was collected in Brazil. Other species reared from *P. citri* were *Leptomastidea* (*Tanaomastix*) *abnormis*, Gir., which was obtained in small numbers in Brazil, and *Anagyrus pseudococci*, Gir., which was common in Buenos Aires, Argentina. *A. pseudococci* was shipped to California, where it was successfully bred on *P. citri* by S. E. Flanders, who states in a note that it did not reproduce readily in cages. The larvae hatched within 44 hours and fed for about 5 days. The life-cycle lasted 18 days at about 78°F. *P. citri* reacted strongly to the presence of the parasitic egg, round which a large irregular melanised cellular mass accumulated, but the larva was sometimes able to maintain an opening in this if the egg hatched before it became too dense. In the shipments from Argentina, fully developed larvae of *A. pseudococci* were parasitised by the immature males of *Coccophagus heteropneusticus*, Comp. [see next abstract].

In the second part of the paper observations are recorded on the mealybugs that occur in South America and also in California. The species commonly found on *Citrus* in Brazil was *P. comstocki*, Kuw., and not *P. citri* [*cf.* **24** 502]. It was present in most of the *Citrus* orchards visited, but was rarely injurious. In Argentina, scattered individuals were observed in one province ; and in Paraguay, several small but very injurious infestations were found on *Citrus* grown as ornamental trees in the streets of Asuncion. *P. comstocki* tends to congregate in small, compact colonies between adhering leaves, within the folds of curled leaves and between contiguous fruits. No evidence of Chalcidoids parasitic on it was obtained in Brazil, but it was attacked

by various predators. In Paraguay, masses of mealybug detritus containing insects killed by parasites were found, but no parasites were obtained. *P. citri* was common on plants other than *Citrus* in Brazil, and several small but injurious infestations were discovered. The predators attacking it included *Hyperaspis c-nigrum*, Muls., two species of *Scymnus* of the subgenera *Nephus* and *Diomus*, Chrysopids and Cecidomyiids. *P. citri* was generally distributed in Buenos Aires and its environs on ornamental plants, but was not usually numerous. Small colonies of *P. citri* and *P. adonidum* were common there on oleander, and the former was also abundant on oleander and other plants in Peru.

P. adonidum was generally distributed in Brazil and was occasionally abundant and injurious to various ornamental plants. In Rio de Janeiro, large numbers were found killed by parasites, and *Tetracnemus peregrinus* was observed ovipositing in young larvae. Nearly all those dissected contained eggs or larvae of this parasite. *P. adonidum* is also rather common on ornamental plants in Argentina. *Phenacoccus gossypii* was observed on tomato, hedge and ornamental plants in Brazil, and local infestations of *Pseudococcus maritimus* occurred on ornamental plants. No internal parasites were found, but predators, including species of *Hyperaspis*, *Scymnus*, *Diplosis* and *Leucopis* were abundant and attacked both species. The most effective against *P. maritimus* appeared to be *H. c-nigrum*, which was introduced into California. In the laboratory in California, *Aenasius paulistus*, Comp. [**26** 212] reproduced in *P. maritimus*. This mealybug was not observed in Argentina, but Lizer Trelles considers that it may be the pest of grape-vines identified there as *P. vitis*, Nied.

COMPERE (H.). **The Insect Enemies of the Black Scale, *Saissetia oleae* (Bern.), in South America.**—*Univ. Calif. Publ. Ent.* **7** no. 5 pp. 75–90, 9 figs. Berkeley, Calif., 1939.

The results are given of investigations in South America in 1934–35 on the natural enemies of *Saissetia oleae*, Bern., with a view to their introduction into California. The Coccid was found in nearly all the localities visited in Brazil, but in tropical districts it was rare on *Citrus* and other plants to which it causes injury in temperate regions. Its commonest food-plants were the indigenous ornamental trees, *Cassia splendens* and *C. imperialis*. Injurious infestations were rare, and the most harmful were usually found on isolated trees in densely built sections of the cities. All stages of *S. oleae* were present in a severe infestation on young cassia trees observed in October 1934, and there was little evidence of parasitism. As the season advanced, parasites became increasingly numerous, and by the end of January 1935 they had controlled the Coccid. Other isolated heavy infestations were similarly controlled by parasites. *S. oleae* was less abundant in the more temperate region of São Paulo, and almost all the examples observed in slight infestations were parasitised. Limited observations in Argentina showed that there *S. oleae* infests some of the plants usually attacked in California. Most of the scales found on oleander in Buenos Aires were brown and dry a few weeks after a record high temperature of 105°F. Live scales containing parasites were found in moist shady places. In Chile, *S. oleae* is far more injurious than elsewhere in South America, and attacks most of the plants that it infests in California, particularly avocado. No evidence of parasites other than those

recently introduced from California was found. In Peru, the scale was observed on oleander, but appeared to be of little importance.

A list is given of 16 Chalcidoid parasites and hyperparasites of *S. oleae* in South America. Five are described as new, the first three from both sexes and the other two from females. They are the Eupelmid, *Lecaniobius utilis*, reared from *S. oleae* in Brazil or Buenos Aires; and the Aphelinids, *Coccophagus heteropneusticus*, reared from *S. oleae* in Brazil and Buenos Aires and also obtained in Brazil from *S. coffeae*, Wlk. (*hemisphaerica*, Targ.) and *Coccus viridis*, Green, and in Buenos Aires from *C. hesperidum*, L., or *S. coffeae* and from *Pseudococcus citri*, Risso; *C. fallax*, from *S. oleae* in Brazil; *C. basalis*, from *S. oleae* and *S. coffeae* in Brazil; and *Aneristus pallidiceps*, from *S. oleae* in Brazil. A key is given to the species of *Lecaniobius*. The material sent to California included all these species except *C. fallax*, which was at first thought to be *C. lycimnia*, Wlk., a species already present there. *C. heteropneusticus* was released but not recovered, *C. basalis* could not be reared in the laboratory, and *A. pallidiceps* died out after one generation there. *L. utilis*, however, became established in at least one orchard in Ventura County. According to S. E. Flanders, it reproduces readily in the insectary, and its life-cycle lasts about 38 days at 75–80°F. Females are twice as numerous as males and usually appear several days after them. Oviposition begins on the day after emergence of the adult from the host, and the eggs are placed beneath mature scales, preferably those that have just begun to oviposit or are about to begin. Several eggs may be deposited beneath one scale, and all of them may hatch, but usually only one larva completes its development. The parasite larva hatches in about 2 days and may remain quiescent for 2 weeks or more if no host eggs are available for it to feed on. In the laboratory, the larval and pupal stages lasted 14 and 16–21 days, respectively. *L. utilis* appears to overwinter in the orchards as a mature larva.

Of the other parasites, all of which were bred from *S. oleae* from Brazil, the Pteromalid, *Scutellista cyanea*, Motsch., which also occurs in California, is believed to be a native of Africa and to have been introduced into South America with infested nursery stock. Three mounted specimens were tentatively identified as *Coccophagus lycimnia*. *Aneristus brasiliensis*, Comp. [*cf. R.A.E.*, A **24** 802] is one of the commonest parasites of *S. oleae* in Brazil, but it failed to reproduce in the insectary in California. Others obtained, mostly in small numbers, were *A. oculatipennis*, Gir., *Euaphycus* sp., *Encyrtus* sp., which may have been parasitic on *S. coffeae* and not *S. oleae*, and 4 species doubtfully referred to *Tomocera*, *Eupelmus*, *Eurytoma* and *Diplosis*, respectively. An Encyrtid of the genus *Gahaniella*, apparently *G. saissetiae*, Timberlake, and *Eupelmus coccidivorus*, Gah., were also obtained. Both are believed to be hyperparasites.

Two species of *Azya* were occasionally observed feeding on *S. oleae* in Brazil, but neither adults nor larvae were abundant. One of them, identified as *A. luteipes*, Muls. (*orbigera*, Muls.), was bred in the laboratory, and adults were liberated in California on trees infested by *S. oleae* in August 1935. Larvae were observed on these trees two months later, but it is not known whether the Coccinellid has become established. Flanders states that males and females occur in approximately equal numbers. Pairing occurs about 1–2 weeks after emergence, and oviposition follows shortly afterwards. The egg, larval and pupal stages last about 6, 15 and 9 days, respectively.

The very young larvae feed on the eggs and first-instar larvae, and the more mature larvae and the adults on the larger scales, but the adults are apparently not attacked. Pupation occurs in sheltered places on the ground. This Coccinellid reproduced readily in the insectary, and one female may give rise to over 100 offspring.

Lundie (A. E.). **The Apple Grower's Insect Ally.**—*Fmg in S. Afr.* 1939 repr. no. 92, 5 pp., 10 figs., 9 refs. Pretoria, 1939.

A brief review is given of the distribution of *Aphelinus mali*, Hald., throughout the world, with an account of its introduction from the United States into South Africa against *Eriosoma lanigerum*, Hsm., on apple, in 1920 [*cf. R.A.E.*, A **9** 185, 282]. The localities in South Africa in which liberations were made in 1921–23 are shown on a map. The Aphelinid now occurs in almost every orchard in which the Aphid is present and controls it so effectively that spraying is unnecessary under most conditions. The development of the parasite in the host is briefly described.

E. lanigerum is attacked in South Africa by the Coccinellids, *Cydonia* (*Chilomenes*) *lunata*, F., *C. propinqua quadrilineata*, Muls., *Scymnus casstroemi*, Muls., *Exochomus melanocephalus*, Zoubkoff (*nigromaculatus*, Goeze), *Pharoscymnus* (*Midus*) *quadristillatus*, Muls., and *Thea* (*Halyzia*) *variegata*, F., and by the larvae of *Syrphus cognatus*, Lw., and probably by *Scymnus binaevatus*, Muls., *Platynaspis* sp., *Oenopia cinctella*, Muls., *Alesia* sp., and *Cydonia propinqua*, Muls. Two unidentified parasites of *A. mali* have been observed there. One of them resembled the Pteromalid, *Asaphes americana*, Gir.

Pettey (F. W.) & du Toit (E.). **Biological Control of Jointed Cactus.**—*Fmg in S. Afr.* 1939 repr. no. 107, 3 pp., 5 figs. Pretoria, 1939.

In an attempt to control the jointed cactus, *Opuntia aurantiaca*, which is a noxious weed in many eastern districts of Cape Province, a strain of the Coccid, *Dactylopius confusus*, Ckll., was introduced into South Africa from South America in November 1932. The original colony, which was part of a consignment destined for Australia, consisted in a few individuals on a single infested joint of cactus. The colony developed very slowly, no larvae appearing for the first six months, and an attempt to infest a large clump of *O. aurantiaca* growing in the experimental garden at Port Elizabeth nearly two years later failed, as the Coccids were immediately destroyed by the Coccinellid, *Exochomus melanocephalus*, Zoubkoff (*nigromaculatus*, Goeze). The first liberation against wild *Opuntia* was made at Uitenhage in June 1935, and there large numbers were bred both in the laboratory and in the field in a comparatively short time. Within 8 months of the liberation, the cactus plants became heavily infested and were to a considerable extent destroyed. When it was known that *D. confusus* was breeding well and spreading rapidly from the original experimental areas, liberations on a wide scale were undertaken. It established itself on *O. aurantiaca* wherever it was liberated and gave effective control of dense areas of cactus, but its efficiency in localities in which the plants are widely and thinly dispersed is not known.

Notes are given on the life-history of *D. confusus*. It has several generations a year, the number apparently depending on climate,

and the larvae are capable of crawling considerable distances, though it is not known to what extent infestation is spread by this means. The males are short-lived. When *O. aurantiaca* is attacked in the field, the Coccid invariably establishes itself at ground level, usually on the lower surface of joints in close contact with the soil. Within approximately 2 months of the date on which infestation is observed, the typical white clusters appear at a number of points throughout the plant, and the outside growth begins to collapse soon afterwards. Within a further 3–5 months, the surrounding growth is entirely killed, and the plant collapses completely 18 months after attack. Some of the larger " tubers " and those a few inches below the ground were found to have survived when this stage was reached, and regrowth from these occurred a year later, but rarely persisted for more than 4 months, when the new growth was heavily infested by Coccids from the underground tubers.

The Coccid is readily spread and easily established by placing infested joints of cactus in close contact with healthy plants. Establishment was more rapid in summer than in winter, but there was little difference in the final result. In dense stands of *Opuntia*, it is sufficient to establish colonies at intervals of 50 yards, but where the plants are scattered, it is advisable to infest as many as can be found.

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Ramchandra Rao (Y.) & Gupta (R. L.). **Some Notes on Eye-stripes in Acrididae.**—*Indian J. agric. Sci.* **9** pt. 5 pp. 727–729, 6 refs. Delhi, 1939. [*Cf. R.A.E.*, A **26** 628 ; **27** 486, 512.]

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